

WL-TR-96-3011

FIRE PROTECTION RESEARCH AND
DEVELOPMENT REQUIREMENTS ANALYSIS FOR USAF
SPACE SYSTEMS AND GROUND SUPPORT FACILITIES
VOLUME II - FIRE PROTECTION OPERATIONAL
REQUIREMENTS DOCUMENTS



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APRIL 1995

FINAL REPORT FOR 03/31/93-04/15/95

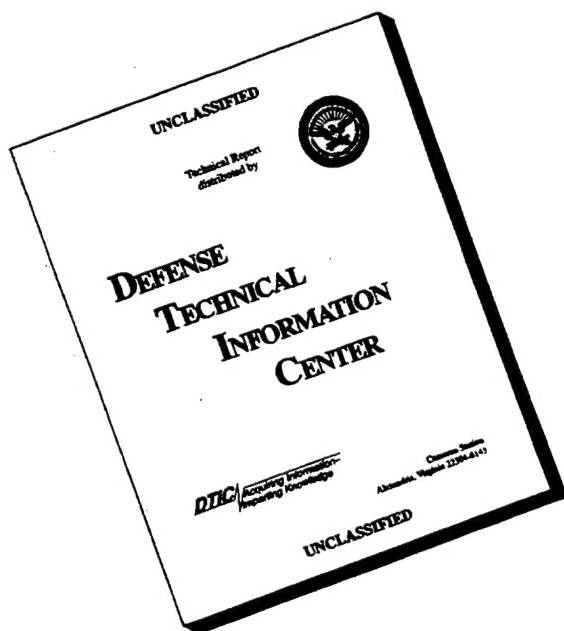
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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE APR 1995	3. REPORT TYPE AND DATES COVERED FINAL 03/31/93--04/15/95		
4. TITLE AND SUBTITLE FIRE PROTECTION RESEARCH AND DEVELOPMENT REQUIREMENTS ANALYSIS FOR USAF SPACE SYSTEMS AND GROUND SUPPORT FACILITIES VOLUME II-FIRE PROTECTION OPERATIONAL REQUIREMENTS DOCUMENTS			5. FUNDING NUMBERS C F08635-93-C-0042 PE 62206 PR TA WU	
6. AUTHOR(S) GEORGE F. HALL, ROSS J. UTT, E. RAYMOND LAKE AND JOHN H. STORM				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AEROSAFE INTERNATIONAL 3033 RICHMOND PARKWAY RICHMOND CA 94806-0113			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) FLIGHT DYNAMICS DIRECTORATE WRIGHT LABORATORY AIR FORCE MATERIEL COMMAND TYNDALL AIR FORCE BASE FL 32403-5323			10. SPONSORING/MONITORING AGENCY REPORT NUMBER WL-TR-96-3011	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This technical effort justified fire protection research and development (R&D) requirements that are unique to the fire departments operating at Cape Canaveral Air Station (CCAS), Florida, and Vandenberg Air Force Base (VAFB), California. Operational uniqueness was established by the mission requirement of these fire departments to conduct fire suppression, rescue and/or hazardous material (HAZMAT) emergency response operations involving the extremely toxic and explosive hypergolic propellants used in space lift vehicles and satellites. The technical approach employed an operational hazard analysis of space launch and payload processing facilities and operations to determine emergency response environments. The final products are a technical report, five (5) draft Operational Requirements Documents (ORDs), a draft Purchase Description (PD), and a draft HAZMAT Emergency Response Plan for civilian contractors.				
14. SUBJECT TERMS			15. NUMBER OF PAGES 324	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT SAR	

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PREFACE

This report was prepared by Aerosafe International, 3033 Richmond Parkway, Richmond, California, for the Wright Laboratory, Infrastructure Technology Section, Fire Research Group (WL/FIVCF), 139 Barnes Drive, Suite 2, Tyndall Air Force Base, Florida 32403-5323. The work was accomplished under Air Force Development Test Center Contract Number F08635-93-C-0042.

The final report presents the results of an analysis to determine fire protection Research and Development (R&D) requirements that are unique to the fire departments operating at Cape Canaveral Air Station (CCAS), Florida, and Vandenberg Air Force Base (VAFB), California. The operational uniqueness is established by virtue of the CCAS and VAFB fire departments' requirement to conduct fire suppression, rescue and/or hazardous material (HAZMAT) response operations involving the unique hypergolic propellants used in lift vehicles and satellites.

The basis of this technical report was an operational hazard analysis of the space launch and payload processing operations to which the fire department must be ready to provide emergency response at Cape Canaveral Air Station (CCAS), FL and at Vandenberg Air Force Base (VAFB), Ca. The analysis required detailed information on fire department policies, procedures and tactics, operational fire fighting apparatus and equipment for space launch facility support, as well as details of installed facility fire protection systems. Additionally, the analysis required site access to the unique payload and launch vehicle processing facilities at CCAS and VAFB to determine infrastructure parameters that influence fire protection systems and operational procedures.

To provide the authors with a full understanding of the propellant-related hazardous operations that are conducted in/on CCAS and VAFB facilities, extensive discussions were conducted with launch support and payload processing contractors, as well as range and pad safety personnel. This information was used to generate hazard scenarios for operations where accidental releases may occur. Space launch-unique operational fire department missions and capabilities were then based on hazard analysis results. Finally, required capabilities were used to identify and validate fire protection research and development (R&D) requirements that are based on firm, space launch operational needs.

The authors wish to express their sincere appreciation to the many individuals who contributed the support and success of this technical effort. They made it possible to gather the extensive data base cited above that was essential to accuracy and validity of the report's findings and conclusions.

Our data collection and operational assessment of Cape Canaveral Air Station, FL, launch support operations and facilities was hosted and supported by the Patrick Air Force Base Fire Chief, Mr. Tom Stevens, and his deputies, Mr. Joseph Giantonio and Chief Master Sergeant (Selectee) Raymond Guerero. Chief Stevens and his staff shouldered a large burden of additional administrative and coordination actions associated with our site visits and analysis results. Without his support and assistance, this effort would not succeeded in fully identifying and supporting space launch fire protection R&D requirements. Mr. John Kinstle of the 45th Space Wing Range Safety Office also provided invaluable support to this technical effort.

The Cape Canaveral Air Station Fire Department is a contractor-operated organization, and a part of Johnson Controls Launch Base Support Contract. Fire Chief Charles Richardson, and his successor, Chief Norbert Kuhman, extended the full courtesies and support of their organization, and the value of their operational experience in the review of our findings and recommendations.

In particular, we wish to acknowledge the support of CCAS Assistant Fire Chief for Fire Prevention, Mr. Henry Pankow. He organized and led our many site visits to the CCAS launch facilities and put us in contact with the operational and Pad Safety professionals needed for our understanding of fire protection hazards and operational requirements.

At Vandenberg AFB, we were provided strong support from Fire Chief Art Hill and his successor, Chief Paul Giles. Our VAFB site visits were organized and hosted by Mr. Ronald Colegrove, from the 30th Space Wing System Safety Office. Mr. Colegrove was an exceptionally cordial host and provided the Wright Laboratory team with access to the VAFB launch and payload processing support contractor community for analysis data base information.

We also wish to acknowledge the dedication and support of Master Sergeant Mark Captain, from the Fire Protection Office at Headquarters Air Force Space Command. Sergeant Captain was a valuable member of our analysis review and validation team. He is the Project Officer for major command staffing and processing of the Operational Requirements Documents (ORDs) that resulted from this technical effort.

Mr. Ross J. Utt, Mr. E. Raymond Lake and Dr. John H. Storm were the Aerosafe International Principal Investigators. The WL/FIVCF Project Officer was Mr. George F. Hall. The analysis was conducted from 31 March 1993 to 15 April 1995.

EXECUTIVE SUMMARY

A. OBJECTIVE

The objective of this analysis was to determine fire protection research and development (R&D) requirements that are unique to the fire departments operating at Cape Canaveral Air Station (CCAS), Florida, and Vandenberg Air Force Base (VAFB), California. Operational uniqueness was established by virtue of the mission requirement for these fire departments to conduct fire suppression, rescue and/or hazardous material (HAZMAT) emergency response operations involving the extremely toxic and explosive hypergolic propellants used in space lift vehicles and satellites.

B. BACKGROUND

The fire departments at CCAS and VAFB are the only two units in the USAF that must be equipped and trained to respond to accidental releases and, possibly, fires involving large quantities of highly toxic and explosive hypergolic propellants. Wright Laboratory's Infrastructure Technology Section, Fire Research Group, (WL/FIVCF), Tyndall Air Force Base, Florida, developed this analysis task to ensure that CCAS and VAFB requirements for improved fire protection technologies are defined and supported in the Civil Engineering research, development and acquisition (RD&A) process. Potential required capabilities include improved fire extinguishing agents, vehicles and equipment, as well as new technology fire and vapor detection systems and fire fighter personal protective equipment (PPE).

C. SCOPE

This research quantifies fire protection R&D requirements generated by the CCAS and VAFB fire department missions to provide suppression, rescue and fire prevention in support of United States Air Force (USAF), Department of Defense (DoD) and commercial satellite launch operations. The final products are a technical report, five (5) draft Operational Requirements Documents (ORDs), a draft purchase description (PD), and a draft HAZMAT Emergency Response Plan for civilian contractors, and two briefing packages on facility life safety requirements standards.

D. TECHNICAL APPROACH

1. The technical approach employed an operational hazard analysis of space launch and payload processing facilities and operations at the CCAS and VAFB launch sites to determine fire department emergency response environments and requirements. The mechanisms and estimated quantities of accidental releases of highly flammable, explosive and toxic hypergolic propellants were quantified.

2. The required fire department operational capabilities for effective fire suppression and rescue emergency response were determined. Inventory fire department agents, vehicles and fire prevention systems were mapped to the identified required capabilities. R&D requirements were established for required capabilities that are not available from inventory assets or off-the-shelf technologies.

3. All analysis findings and recommendations were validated by the Air Force Space Command fire protection community and reviewed by the CCAS and VAFB safety offices.

E. HYPERGOLIC PROPELLANT HAZARD ANALYSIS CONCLUSIONS

1. The probability of an accidental release of hypergolic chemicals at CCAS or VAFB is low. This low release incidence estimate is founded on the space launch community's strictly-enforced system safety programs, the use of strictly-controlled propellant transfer operations procedures, and effective maintenance of propellant storage and handling facilities and equipment.

2. Credible release quantities of hydrazine fuels or oxidizer that are likely to result from accidents, transfer system material failures or human error range from 0.1 to 400 gallons.

3. A catastrophic propellant release was judged to be possible, but highly improbable. Releases above 400 gallons were not considered by this technical effort. A very large propellant release would generate requirements for large additional amounts of fire fighter manpower, agent and equipment resources. It would not generate the requirement for unique fire department technologies. The unique fire department operational requirements identified by this analysis for releases up to 400 gallons apply equally to larger events.

4. CCAS and VAFB fire fighters cannot safely conduct suppression and/or rescue operations in the vicinity of the toxic vapors and combustion products associated a hypergolic propellant vapor release and fire. Current fire fighter reflectorized ensembles do not provide the full encapsulation required by OSHA for protection against propellant toxic vapors. Inventory fully-encapsulated fire fighter HAZMAT suits will melt in the proximity of a fire.

5. Many different civilian contractor companies are involved in hypergolic propellant transfer operations or have employees who may be nearby an accidental release. Therefore, consistent OSHA-compliant hazardous chemical release emergency response plans, procedures and training are required to ensure the life safety of personnel.

6. CCAS and VAFB fire fighters urgently need live fire-validated extinguishing agent performance data to plan for safe and effective hydrazine and N_2O_4 -enriched fire fighting and rescue operations.

7. Personnel working inside elevated launch tower clean rooms or who may be working on launch towers in the proximity of other hazardous systems/operations require a direct, rapid, emergency egress system from the elevation where the hazardous operation takes place to the ground, below.

F. FIRE DEPARTMENT REQUIREMENTS FOR INCREASED OPERATIONAL CAPABILITIES

1. A draft Operational Requirements Document (ORD) was prepared and delivered to HQ AFSPC for the development, testing and acquisition of each fire protection technology requiring R&D. Required capabilities were prioritized by the AFSPC fire protection community, as follows:

a. A combined fire fighter/HAZMAT protective ensemble with body cooling for sustained fire fighting and rescue operations in a dual threat hypergolic propellant fire and toxic vapor environment.

b. Hydrazine vapor detection capable of incipient leak identification in the 1 - 25 parts per million (ppm) concentration range.

c. An additive to water, foam and dry chemical fire extinguishing agents that produces a visible flame and/or smoke when applied to a hydrazine fire.

d. False-alarm immune hydrazine flame detection.

e. Optimization of fire extinguishment parameters and capabilities for current technology agents, such as water, dry chemicals and foams (including acrylic-modified foams) based on large fire (400 gallons/5,000 square feet) experiments.

2. Two operational requirements that are not within current inventory capabilities, but can be obtained from off-the-shelf technologies also were validated:

a. Life safety upgrades in MST launch tower clean room facilities, to include means of egress from high elevation hazard areas. A draft purchase description (PD) for a portable emergency escape chute system was delivered to HQ AFSPC.

b. OSHA-compliant, launch tower emergency response plans and procedures for civilian contractors and their employees. A draft contractor HAZMAT Emergency Response Plan was delivered to HQ AFSPC.

G. RECOMMENDATIONS

1. Headquarters Air Force Space Command should:

a. Approve the five ORDs for enhanced fire protection capabilities at space launch support facilities.

b. Submit these ORDs for Air Force-wide review and validation, according to the procedures contained in AFI 10-601, *Mission Needs and Operational Requirements Guidance and Procedures*, 31 May 1994.

c. Advocate joint sponsorship of the ORD for the combined fire fighter/HAZMAT protective ensemble with body cooling to the Combat Air Forces (CAF) and joint services.

2. Commanders at CCAS and VAFB should review the draft HAZMAT emergency response plan and the draft purchase description for a launch tower emergency escape chute system for potential use as enhancements to their on-going emergency response and OSHA process safety management (PSM) programs.

H. APPLICATION

1. The flame and vapor detection technologies identified by this analysis can be applied immediately to CCAS and VAFB propellant storage facilities and payload processing clean rooms. The chemical luminescence additive to permit the visible identification of hydrazine fires can be used immediately by the CCAS and VAFB fire departments.

2. The combined fire fighter/HAZMAT protective ensemble with body cooling is applicable immediately to all Air Force, DOD, NASA, DOE and other Government personnel who require the use of fully-encapsulated equipment for toxic chemical and/or fire fighting protection.

3. Once fire fighting agent suppression effectiveness parameters for large scale hypergolic propellant fires are identified by R&D, this information can be used by CCAS and VAFB fire departments to develop tactics, procedures, apparatus and equipment for optimum fire extinguishment response to hypergolic fuel and oxidizer releases and fires.

I. BENEFITS

The potential benefits from the identified R&D technologies include:

- More rapid and reliable detection of hydrazine vapor releases and fires,
- Increased life safety of personnel involved in hypergolic propellant hazardous operations and in emergency response to accidental HAZMAT releases,
- The capability to extinguish hypergolic propellant fires in a toxic vapor environment,
- A significant increase in fire fighter operational sustainability while wearing a protective ensemble, and,
- More effective and safer extinguishment of hypergolic propellant fires.

J. TRANSFERABILITY OF TECHNOLOGY

1. Potential non-DOD users of flame and vapor detection technologies, of the chemical luminescence additive, and of optimum fire extinguishing agents include chemical producers of hydrazines and industrial fire brigades in facilities or plants that use and store hydrazines.

2. The technologies associated with the combined fire fighter/HAZMAT protective ensemble with body cooling are transferable to all fire department and commercial organizations that are involved in processes that require employees to be protected against the effects of toxic chemicals and/or fires involving HAZMATs. Fundamentally, the ensemble technologies are universally transferable, worldwide.

3. All technologies identified for enhanced fire department support of space launch operations and facilities are transferable to foreign and commercial organizations with similar hazardous processes, facilities and missions.

SECTION I

INTRODUCTION

A. OBJECTIVE

1. The objective of this analysis was to determine fire protection research and development (R&D) requirements that are unique to the fire departments operating at Cape Canaveral Air Station (CCAS), Florida, and Vandenberg Air Force Base (VAFB), California.

2. Operational uniqueness was established by virtue of the mission requirement for these fire departments to conduct fire suppression, rescue and/or hazardous material (HAZMAT) emergency response operations involving the extremely toxic and explosive hypergolic propellants used in space lift vehicles and satellites.

B. BACKGROUND

1. The fire departments at CCAS and VAFB are the only two units in the USAF that must be equipped and trained to respond to accidental releases and, possibly, fires involving large quantities of highly toxic and explosive hypergolic propellants. Their mission is to provide structural, crash, rescue, and fire prevention capabilities for the launch support facilities, space launch vehicles, payloads, and hazardous propellant storage and transfer facilities involved in United States Air Force (USAF, DoD and commercial satellite launch operations.

2. Hypergolic chemicals are extremely dangerous to fire fighting and rescue operations:

a. The fuels, Anhydrous Hydrazine, AH (N_2H_4), and its derivatives, monomethylhydrazine, MMH (CH_6N_2), unsymmetrical dimethylhydrazine UDMH ($C_2H_8N_2$) and Aerozine 50 (A-50), a 50:50 percent mixture of AH and UDMH, spontaneously and violently react when contacted with oxides, such as rust, dust and debris, flame or spark.

b. The oxidizer, nitrogen tetroxide (N_2O_4) is not combustible, but will enrich a hydrocarbon fuel fire producing a more violent flame and much higher temperatures.

c. Both fuels and oxidizers are extremely toxic by inhalation and skin contact routes.

3. In 1990, the Engineering and Services Space Liaison Group was chartered to determine the roles and missions of Civil Engineer organizations in the newly-formed Air Force Space Command (AFSPC). The group explicitly stated the requirement for research in Space Command-unique technology areas: *"R&D in the Fire Protection area is mandatory - a link we have to pursue....combating rocket fuel fires and crash rescue for space lift support are immediate problems."*

4. Wright Laboratory's Infrastructure Technology Section, Fire Research Group, (WL/FIVCF), Tyndall Air Force Base, Florida, developed this analysis task to ensure that CCAS and VAFB requirements for improved fire protection technologies are defined and supported in the Civil Engineering research, development and acquisition (RD&A) process. Potential required capabilities include improved fire extinguishing agents, vehicles and equipment, as well as new technology fire and vapor detection systems, and fire fighter personal protective equipment (PPE).

C. SCOPE

1. This research quantifies fire protection R&D requirements generated by the CCAS and VAFB fire department missions to provide suppression, rescue and fire prevention in support of United States Air Force (USAF), Department of Defense (DoD) and commercial satellite launch operations. The final products are a technical report, five (5) draft Operational Requirements Documents (ORDs), a draft purchase description (PD), a draft HAZMAT Emergency Response Plan for civilian contractors, and two briefing packages on facility life safety requirements standards.

2. The ORDs and the PD identify required increases in fire protection capabilities that are justified by this analysis and operationally-validated by the AFSPC fire protection community. ORDs identify fire protection and prevention needs that cannot be met from off-the-shelf-technologies and, therefore, require research, development and acquisition.

3. The PD provides procurement information for the local purchase of hardware to improve launch tower life safety. The HAZMAT Plan is for CCAS and VAFB support contractor's use to enable full compliance with OSHA requirements for worker safety in the event of an accidental release of a hypergolic chemical. The briefing packages present a requirements analysis process to identify life safety deficiencies and to determine which Air Force, Department of Defense or national standards apply.

SECTION II

DOCUMENT ORGANIZATION

A. SUMMARY

This final technical report is organized in two volumes. Volume I contains the space launch facility fire protection operational requirements analysis and results. Volume II contains operational requirements documentation and data on the storage and delivery of hypergolic commodities during the various stages of launch vehicle and payload processing servicing and support.

B. VOLUME I ORGANIZATION

1. In Volume I, Section II describes typical launch facilities that require fire prevention technical support and fire-rescue operational response from the CCAS and VAFB fire departments. Section III details the technical approach used by this analysis to determine CCAS and VAFB R&D requirements based on validated operational needs. In Section IV, the chemical and combustion properties of hypergolic propellants are summarized. Section V describes the methodology used to determine the knowledge base of unique fire department operational requirements that result from the CCAS/VAFB missions to support the Air Force's space launch programs. Five specific operational requirements are identified.

2. Volume I, Section VI, provides descriptions and capacities of the mobile trailers and portable containers used to store and transport hypergolic propellants on CCAS and VAFB. Similarly, in Section VII, descriptions of fixed, bulk propellant storage facilities are provided. An explanation of hypergolic propellant flow charts is provided in Section VIII. Flow charts define the receiving, storage, handling, distribution and end use paths of each hypergolic propellant used on CCAS and VAFB.

3. In Volume I, Section IX describes the hazard analysis performed on CCAS and VAFB to identify the hypergolic propellant release scenarios and mechanisms that could require fire department emergency response. Quantities of hypergolic propellant associated with each release mechanism are computed in Section X.

4. Hazard analysis results and accidental release quantities are used as the basis for determining hypergolic propellant-related operational requirements for improved fire department capabilities in Section XI. Seven operational requirements are identified for capabilities that exceed inventory assets. Five require R&D, and two can be obtained from off-the-shelf sources.

5. The summary, conclusions and recommendations of this technical effort are detailed in Section XII.

C. VOLUME II ORGANIZATION

1. In Volume II, Appendix A - Appendix E contain draft Operational Requirements Documents (ORDs) for mission-essential capabilities that cannot be met from off-the-shelf technologies. Appendix F contains a draft purchase description for a launch tower emergency escape chute system and associated vendor product information. In Appendix G, a draft HAZMAT Emergency Response Plan for CCAS and VAFB contractor use is provided.

2. Volume II also contains flow charts that detail the storage, transportation and end-use distribution of hypergolic propellants on CCAS and VAFB. They are organized by product, by container size and by end-use destination to an Air Force launch pad or payload processing facility. The flow charts depict the complete range of potential accidental release hazards caused by propellant transfer or transportation incidents. Appendix H contains CCAS flow charts, and Appendix I contains flow charts for VAFB.

3. Appendix J in Volume II contains a briefing package entitled *45th Space Wing Launch Site Fire Protection & Life Safety Requirements Analysis*. Appendix K contains a briefing package entitled *Standards Compendium, 45th Space Wing Launch Site Fire Protection & Life Safety Requirements Analysis*.

APPENDIX A

DRAFT OPERATIONAL REQUIREMENTS DOCUMENT (ORD)
FOR A
COMBINED FIRE FIGHTING/HAZMAT ENSEMBLE WITH BODY COOLING

**OPERATIONAL REQUIREMENTS DOCUMENT (ORD) FOR A
COMBINED FIRE FIGHTING/HAZMAT ENSEMBLE WITH BODY COOLING**

1. General Description of Operational Capability:

a. The fire departments at Cape Canaveral Air Station, Florida (CCAS) and at Vandenberg Air Force Base, California (VAFB) are the only two units in the USAF that must be equipped and trained to respond to accidental releases and fires involving very large quantities of highly toxic hypergolic fuels, hydrazine and its derivatives, and nitrogen tetroxide, a hypergolic oxidizer. Their mission is to provide structural, crash, rescue, and fire prevention capabilities for the launch support facilities, space launch vehicles, payloads, and hazardous propellant storage and transfer facilities involved in United States Air Force (USAF) and commercial satellite launch operations. Hydrazine-based fuels are used in small quantities at bases supporting F-16 and B-2 APU systems, and Peace Keeper strategic missiles. However, special fire fighting agent requirements have not been identified.

b. A combined fire fighting/HAZMAT ensemble with body cooling is required to enable CCAS and VAFB fire departments to safely conduct effective fire fighting and rescue operations in a combination threat flame and toxic propellant chemical environment with minimum manpower. Current fire fighter reflectorized bunker ensembles do not provide the full encapsulation required by OSHA for protection against the propellant toxic vapors. Additionally, current inventory fully-encapsulated fire fighter HAZMAT suits will melt in the proximity of a fire. Furthermore, existing fire fighter and HAZMAT ensembles provide no external source for body cooling. This limits fire fighter productivity and capability for strenuous tasks, such as fire fighting and rescue operations, to about 15 to 20 minutes of continuous operations, because of dehydration and heat exhaustion effects.

c. CCAS and VAFB fire fighters urgently need specifically designed personal protective equipment (PPE) for fire fighting operations involving exposure to the combined flame and the highly toxic liquid and vapor effects of hypergolic propellants. These chemical mixtures can be deadly and are extremely dangerous. A combined fire fighting/HAZMAT ensemble with body cooling is required to provide fully-encapsulated liquid and vapor chemical protection, proximity flame and heat protection, and body heat removal for extended operations in a toxic environment. Chemical and flame protection are required from the following propellants:

(1) Anhydrous Hydrazine, AH (N_2H_4), and its derivatives, monomethylhydrazine, MMH (CH_6N_2), unsymmetrical dimethylhydrazine UDMH ($C_2H_8N_2$), and Aerozine 50 (A-50), a 50:50 percent mixture of AH and UDMH. Hydrazines are extremely toxic by inhalation and skin contact routes, and they burn at a flame spread rate that is about 10 times as fast as a hydrocarbon fuel fire. Therefore, it is more intense and spreads faster. Hydrazines spontaneously and violently react when contacted with oxides, such as rust, dust and debris, flame or spark.

(2) Nitrogen Tetroxide (N_2O_4). This oxidizer is not flammable. However, when added to a fire, it enriches the fire intensity of combustion and burning rate by providing an additional oxygen source. Nitrogen tetroxide and its vapors explode on contact with hydrazine fuels, amines and furfuryl alcohol. Additionally, it can cause ignition on contact with wood, paper and hydrocarbon fuels. Oxidizer-enriched fires will produce more heat and be more difficult to extinguish. Intense white flames can be produced. The smoke signature produced is that normally associated with NFPA Class A (wood & paper products) and B fires (hydrocarbon fuels). This chemical is extremely toxic, and presents a serious health risk through skin and eye contact, and inhalation routes. It reacts with skin moisture and with water in the lungs to produce nitric and nitrous acids that destroy contacted tissues.

d. This capability is an immediate requirement, since CCAS and VAFB launch operations are projected to continue to increase over the next several years. These operations will result in increases of the frequency of hypergolic propellant transportation, transfer and use in launch vehicles and payloads. In turn, these hazardous operations will increase the overall probability of an accidental release with the potential for a fire situation to result.

e. This ORD is in direct support of the Air Force Space Command's Mission Need Statement (MNS), AFSPC XX-YY, ----- (TBD AFSPC staff action. Look for a MNS for military space lift support and a different one for commercial support.) This(These) MNS is/are in direct support of OUSD (A) Mission Area (s) XXX, YYY----- (TBD AFSPC staff action).

f. This ORD also supports Air Combat Command (ACC) MNS CAF 311-90, New Generation of Fire Fighting and Crash Rescue Systems, which identifies the need for improved fire fighter life support systems and personal protective equipment (PPE). A combined fire fighting/HAZMAT ensemble with body cooling that meets the performance and protective requirements for use against hypergolic propellant flame and chemical contact and vapor hazards will have wide

application at non-space launch installations for hazardous material (HAZMAT) spill/release response operations and structural and aircraft fire fighting that involves toxic chemicals and/or HAZMAT.

g. The Requirements Correlation Matrix (RCM) for a combined fire fighting/HAZMAT ensemble with body cooling is at Attachment 1.

2. Threat:

a. The primary causes of hypergolic chemical release and potential fires at CCAS and VAFB that would require fire fighter suppression and rescue response in a combined toxic chemical-propellant fire fighting environment are accidents during lift vehicle and payload processing operations. These normally occur during the transfer of propellant chemicals from bulk or mobile storage containers into a launch vehicle or payload on-board fuel tank. Hazard analyses were conducted to determine the mechanisms and locations of accidents or incidents on CCAS and VAFB that would involve the release of hypergolic propellants and, consequently, trigger a fire department emergency response.

b. Accidental releases of hypergolic propellants on CCAS and VAFB were assumed to result from incidents involving propellant containers, mobile tanker-trailers, and/or the transfer equipment used to pump and distribute the commodities from one container to another, or into the launch vehicle and payload on-board tanks. The potential locations where such accidents were most likely to occur were determined by mapping the receipt, storage and end-use distribution flow chart-histories of hydrazine fuels and nitrogen tetroxide on CCAS and VAFB.

c. Nine accidental hypergolic chemical release hazard scenarios resulting from common space launch system processing and support operations at CCAS and VAFB were identified. These scenarios represent a spectrum of generalized hypergolic chemical/fire threats facing the CCAS and VAFB fire departments. Each can generate a fire department requirement to provide fire suppression, rescue and/or HAZMAT emergency response, or a combined fire-HAZMAT operation. They are:

(1) Accident during propellant storage container sampling operation. The release mechanisms are over-filled glass sample bottles, dropped glass sample bottles, and the improper seating of sample draw equipment connections.

(2) Accident during propellant container or mobile tanker maintenance. The propellant is released when an access port or container penetration component at or near the bottom of the container is removed with residual

chemical remaining. This causes the gravity flow of the propellant on to the pavement or ground below.

(3) Roadway vehicle accident involving propellant containers or tanker-trailers. The release mechanism is assumed to be a puncture or break in the portable hypergolic propellant container or tank that results from damage sustained in a transportation vehicle accident.

(4) Loading or unloading accident involving a dropped propellant container. A puncture or break in a portable hypergolic propellant container is assumed to result from damage sustained in a container loading/off-loading accident.

(5). Vehicle accident involving propellant sample containers. Assumed release mechanisms are broken glass sample bottles and/or damaged Hoke bottles. Exterior carrier containers are assumed to have broken open. The propellants are assumed to be released at the accident site.

(6) Transportation or mating accident involving a fueled satellite payload. Two primary release mechanisms are assumed. The first is caused by impact or shock to the payload propellant system from the accident situation. This would then cause a break or material failure (such as at a weld or pipe connection) in a tank or distribution line. The second mechanism is assumed to be a penetration of a propellant tank by another rigid object. In both cases, propellant would escape under pressure to the surrounding area. The propellant could be contained within the satellite's transportation shroud or released to the open air in a clean room or outdoor accident site.

(7) Propellant transfer accident at bulk storage facilities. Three release mechanisms are assumed: (a) Improper seating or failure of connection hardware of stainless steel flexible transfer hose sections, (b) Minor material failure of stainless steel flexible hose section, such as a small tear, split or rupture. (c) Major material failure of stainless steel flexible hose during propellant transfer operation or Propellant Transfer Unit component material failure.

(8) Propellant release accident during launch vehicle fueling or defueling operations. Release mechanisms and volumes are identical to those defined in the previous sub-paragraph for bulk storage facility propellant transfer accidents.

(9) Accidental release during propellant transfer operations in payload processing facility clean rooms. Assumed release mechanisms are: (a) Improper seating or failure of connection hardware of stainless steel flexible transfer hose sections, and, (b) Material failure of stainless steel flexible hose section, such as a small tear, split or rupture.

Attachment 2 provides a summary of these propellant incident scenarios, the corresponding expected release quantities and fire threat consequences.

d. *"Sabotage Threat To USAF Space Launch Facilities"*. (TBD AFSPC staff action. Look for a specific threat dealing with CCAS and VAFB terrorist activities & sabotage involving hypergolic propellant storage tank or transfer vehicles or the launch vehicles at the pads).

e. *"Threat Compendium, Worldwide Threat To Air Bases: 1991-2001"*, 31 Dec 91. Provides descriptions of the systems, weapons, and organizations representing an air- and land-based threat to USAF Bases. (TBD AFSPC staff action. The terrorist threat to CCAS & VAFB may be contained in this document. If so, cite this document in both paragraph d & e).

3. Shortcomings of Existing Systems:

a. Hypergolic Propellant Fire Response Scenario. The following credible operational scenario depicts the severe threat environment faced by CCAS and VAFB fire fighters: a combined toxic chemical release with fire. Current fire fighter protective ensembles do not provide a combined HAZMAT-flame protective capability or body cooling to prevent heat exhaustion and dehydration from strenuous exercise in a heavy, insulating ensemble.

(1) Fire fighters responding to a hydrazine or hydrazine derivative fire will have to deal with an almost invisible fire that produces little or no smoke. They will have extreme difficulty in determining where the fire boundaries are, the total fire size and the rate of fire spread. Additionally, they will be exposed to a highly toxic chemical atmosphere caused by both the non-combusted hydrazine fuel in the area, as well as the toxic products of combustion from the fire source.

(2) Unless there is an eyewitness account, it will be very difficult to pinpoint the source of the released hydrazine fuel and the flow mechanism, such as gravity-fed or pressurized leaks. Therefore, fire fighters can impinge on a dual threat area consisting of both fire and toxic vapor hazards, without any visible warnings. Following initial agent application, reignition from hot

metal surfaces or fire burn-back from foam decay can occur, or secondary fires involving collateral materials, vehicles or facilities may be ignited by the hydrazine fire. "Invisible" pockets of hydrazine fires will continue to burn until permanently extinguished or until the fuel source is depleted. Toxic vapors will continue to be produced by both the released chemical and by combustion products in the event of a fire.

(3) Rescue attempts will be similarly dangerous. Incomplete or partial extinguishment can leave several pocket fires in the path of rescue personnel. These will also be virtually invisible if hydrazines are involved. Fire fighters can unexpectedly enter a fire area they did not know was there on their way to or from a rescue site with or without a rescue victim in tow. Because of the usually windy conditions associated with the California and Florida coastal locations of USAF launch sites, such a situation would be extremely dangerous for larger fires in the 100 - 400 gallon or larger range.

(4) Accidental spills of hypergolic oxidizer, nitrogen tetroxide, are not expected to produce a fire response requirement for CCAS and VAFB fire departments. However, extensive fire fighter emergency response support may be required for search and rescue operations, as well as for foam agent application for toxic vapor suppression. The fire fighting objective in an oxidizer release response is to prevent spontaneous combustion of other fuel sources, such as hydrocarbons, engine exhausts and organic combustibles, that may come into contact with the nitrogen tetroxide liquid or vapors. All fire fighter responses to oxidizer releases must be treated as a HAZMAT emergency response. Accordingly, fire fighters must be protected to the OSHA Level A standard (29 CFR 1910.120, Appendix B) that requires the wear of a fully-encapsulated ensemble and SCBA.

b. The current inventory Air Force structural and crash firefighting ensembles do not fully protect fire fighters from the vapor and liquid contact effects of hypergolic propellants or the increased flame temperatures associated with hydrazine and oxidizer-enriched fires. Most hypergolic chemical release scenarios involve pressurized propellant transfer systems, therefore, CCAS and VAFB fire fighters are most likely to conduct operations in the proximity of a pressurized leak source where liquid or vapor contact are highly probable.

c. Hypergolic chemical skin contact and inhalation threats to fire fighters produce severe health hazards. Nitrogen tetroxide liquid or vapor contact with skin moisture results in the formation of burns and potential blood transfer. Also, it reacts with moisture in the lungs

to produce nitric and nitrous acid that destroy contacted tissue. Similarly, liquid hydrazine may penetrate the skin and produce severe effects at high doses. Both hydrazine vapors and the combustion products of hydrazine fires are extremely toxic.

d. Fire department response to the accidental release of hypergolic propellants, with or without the presence of a fire, is classified as a **Hazardous Material Emergency Response**, as defined by OSHA 29 CFR 1910.120 (q) and implemented in NFPA 471, *Responding To Hazardous Materials Incidents*. Because hypergolic propellants are highly toxic via inhalation and skin contact routes, OSHA and NFPA require Level A protection ("To be selected when the greatest level of skin, respiratory and protection is required") for CCAS and VAFB fire fighters conducting emergency operations in their presence. The major fire fighter ensemble components to provide this level of protection are a totally-encapsulating chemical protective suit and a positive pressure, full face-piece self-contained breathing apparatus (SCBA) that is worn inside the encapsulating suit. Current Level A HAZMAT ensembles used by USAF fire departments are not flame- and heat-resistant, and, therefore, are not useable for CCAS and VAFB hypergolic propellant release incident response.

e. An additional shortcoming of the existing fire fighter ensemble is the limited sustainability of the individual during a HAZMAT or fire response due to heat stress/fatigue. Fire fighter response to hypergolic chemical incidents at CCAS and VAFB will be conducted in accordance with OSHA/NFPA protocols for incident command and management. These include the requirement for strict entry control procedures to the incident site and full decontamination of the firefighter/ensemble following completion of operations in the "hot" zone, or when individual breathing air reserve limits are reached.

f. Studies have demonstrated that fire fighters produce in excess of 500 watts (400 Kcal/hr) of body heat during strenuous fire fighting and/or rescue operations. Additionally, fire fighter tasks may be conducted in the proximity of a fire environment. This adds both convective and radiant heat energy to the fire fighter inside his protective ensemble. The body's main cooling mechanism is heat loss caused by sweat evaporation. The current firefighter ensemble permits about 22 percent of the maximum evaporative cooling possible, for a heat reduction of 285 watts (245 Kcal/hr). This is greatly exceeded by the fire fighter's metabolic heat build up, even without considering flame-induced additional heat loadings. Accordingly, heat exhaustion and collapse can occur within 20 minutes, depending on individual tolerances and exertion levels.

g. Since CCAS and VAFB fire fighter response to hypergolic chemical releases and fires requires a fully-encapsulated ensemble, almost no evaporative body cooling can occur during incident response. This condition further limits firefighter sustainability and capability at CCAS and VAFB.

h. Current firefighter ensemble weight and bulk further increase the individual's task exertion level and heat buildup. They also limit fire fighter mobility and dexterity. A major factor in fire fighter response to hypergolic chemical release (with or without the presence of fire) can be actions to identify and terminate the release mechanism. These tasks generally require the capability for unrestricted vision and digital dexterity for maximum safety and effectiveness. The current fire-resistant ensemble was not designed for HAZMAT response operations.

4. Capabilities Required.

a. System Performance:

(1) Performance Parameters

(a) The ensemble outer garment, gloves, boots and helmet must provide proximity heat protection for 5 minutes at 3,000 ° F.

(b) The ensemble must be certified as resistant to anhydrous hydrazine and its derivatives and nitrogen tetroxide. Resistance to hydrocarbon fuels and other hazardous chemicals shall be provided to the maximum extent possible, given availability, cost and supportability considerations.

(c) The ensemble shall meet the following National Fire Protection Association (NFPA) standards:

1 NFPA 1991, Vapor-Protective Suits For Hazardous Chemical Emergencies.

2 NFPA 1992, Liquid Splash-Protective Suits For Hazardous Chemical Emergencies.

3 NFPA 1972, Helmets For Structural Fire Fighting.

4 NFPA 1976, Protective Clothing For Proximity Fire Fighting.

5 NFPA 1973, Gloves For Structural Fire Fighting.

6 NFPA 1981, Open-Circuit Self - Contained Breathing Apparatus For Fire fighters.

7 NFPA 1971, Protective Clothing For Structural Fire Fighting.

(d) The ensemble's body cooling subsystem shall provide the following capabilities:

1 400 watts per hour of body cooling heat removal. 550 watts per hour of body cooling heat removal is highly desirable.

2 Cooling output must be controllable by the wearer.

3 The cooling system must be self-contained. It must be carried on the body with no connections to external support equipment.

4 1-hour duration of continuous body heat removal at 400 watts per hour. A 2-hour duration and 550 watts per hour body heat removal rate are highly desirable.

5 Body cooling garment coverage: head, torso, biceps and thighs.

(e) The self-contained breathing apparatus (SCBA) must provide a minimum one (1) hour rated duration and meet all requirements of NFPA 1981 for a positive pressure SCBA. A two (2)-hour rated duration is highly desirable.

(f) The combined SCBA and body cooling system, to include storage containers, face plate, body cooling garment and working fluids must weigh less than 60 pounds. The SCBA system alone, to include the storage container, face plate and associated valves and regulators, shall weigh no more than 35 pounds. The SCBA and body cooling system must fit the 5 to 95 percentile of the population.

(g) The SCBA back pack thickness (projection from the user's back) must be no greater than 8 inches. The SCBA back pack and all associated equipment shall be designed with rounded corners and with no projections that would inhibit fire fighter entry into or out of confined spaces in the upright or prone positions.

(h) The ensemble system must provide the capability for the user to communicate with nearby personnel by voice. The communications test requirements of NFPA 1981 must be met. In addition, the system must include an

interface to allow the user to transmit and receive voice communications on current fire fighter, hand-held, radios.

(i) The ensemble's head and face protection must provide at least 120 degrees of unobstructed vision.

(j) The entire ensemble, as a unit, and as a series of individual components, must enable fire fighter flexibility and dexterity to perform normal fire suppression, rescue and HAZMAT response operations and tasks. These include walking, crawling, climbing ladders, handling manual and motorized tools and equipment, connecting hose lines and adjusting fire apparatus valves and controls, transporting and operating hand-held hose lines and nozzles, entering, operating and exiting fire fighting vehicles, and operating crash vehicle agent delivery systems/monitors from cab work stations.

(k) The combined fire fighting/HAZMAT ensemble with body cooling must be user-tested under live fire and simulated HAZMAT operational conditions and scenarios prior to design acceptance and authorization for production.

(l) The ensemble system shall include a portable, skid-mounted, resupply system for replenishment of breathing air and body cooling working fluids/gases.

1 The resupply system shall be designed for installation at the fire station and onboard a HAZMAT or other support vehicle.

2 The resupply system shall be capable of fully reservicing the breathing air and body cooling systems to full capacity in no more than 5 minutes.

3 The resupply system shall operate on 110/120 volt, 50 or 60 cycle electrical power.

(2) SEEK EAGLE Requirements. Not Applicable.

c. Logistics and Readiness:

(1) Operational Availability

(a) The combined fire fighting/HAZMAT ensemble with body cooling must be capable of repeated use, to include exposure to flame, heat and toxic chemicals and decontamination with neutralizing chemicals, during fire fighting, rescue and HAZMAT response operations and training exercises with a minimum of servicing and maintenance.

(b) The ensemble safe service life shall be at least 60 months following removal of components from their shipping containers. An organizational testing system shall be required to determine ensemble component serviceability after the designated service life has been reached.

(c) All ensemble components must operate at normal performance levels after extended storage in HAZMAT vehicles or fire station locker configurations with no more than minor field level maintenance.

(d) Mean Time Between Maintenance. TBD.

(e) Mean Repair Time. TBD.

(2) Expected Maintenance and Manpower Skill Levels. The combined fire fighting/HAZMAT ensemble with body cooling shall require no increase in CCAS/VAFB fire department extinguisher maintenance or facility support contractor personnel equivalent manpower. The ensemble shall be maintainable by 3- and 5-skill level technicians. Manufacturer's contract maintenance and CCAS/VAFB launch support contractor maintenance options shall be considered during system life cycle cost analysis and acquisition approach planning.

(3) Logistics Supportability And Readiness Requirements.

(a) The combined fire fighting/HAZMAT ensemble with body cooling will be logistically-supportable by CCAS and VAFB base supply organizations and systems. Contract maintenance is TBD.

(b) Ensemble components and systems shall be operable and maintainable under the CCAS and VAFB design climactic conditions of temperature, humidity, rain, and sea salt spray for exterior electronic systems.

(c) The required dry storage temperature range for the ensemble is from - TBD to +140 °F.

(d) All ensemble components shall be logistically supportable and maintainable by non-Air Force Space Command fire departments at CONUS and overseas locations.

d. Critical System Characteristics

(1) Mandatory Characteristics.

(a) Expected Mission Capability. The combined fire fighting/HAZMAT ensemble with body cooling will provide OSHA-compliant personal protection for fire fighters engaged in fire suppression and/or rescue operations in toxic chemical environments. The body cooling system will increase fire fighter sustainability in fire fighting, rescue and HAZMAT response operations from approximately 20 minutes to over 60 minutes, depending on the fitness level of the individual fire fighter, and the final configuration capacity of the SCBA and body cooling systems. The SCBA and body cooling resupplying system will enable rapid resupply of air and cooling working fluids/gases in mobile field and fixed fire station locations.

(b) Electronic Counter-Countermeasures (ECCM) and Wartime Reserve Modes (WARM) Requirements. Not Applicable.

(c) Conventional, Initial Nuclear Weapons Effects, Nuclear, Biological, and Chemical Survivability. Not Applicable.

(d) Environmental Factors. The combined fire fighting/HAZMAT ensemble with body cooling and resupplying system will be capable of all required performance characteristics under all climatic and temperature conditions expected at CCAS and VAFB.

1 Operational temperature ranges are from TBD to + 140 °F.

2 Ensemble components and systems must incorporate appropriate environmental storage control systems and fabrication materials to prevent damage from cold, heat, humidity or thermal expansion.

3 Materials used in the fabrication of ensemble and resupplying system components will not support the growth of fungi to the best commercial practices.

4 Ensemble component and resupplying system performance capabilities will not be adversely affected by wind-blown dust, sand or sea salt spray.

5 Ensemble outer garment components will withstand the UV effects of sunlight with minimal material degradation for the system service life.

6 Environmental requirements for weather seals, air tightness, humidity, marine atmosphere, low temperature, temperature shock, heat transfer, blowing sand, dust, UV effects, solar loads and water tightness shall be IAW MIL-STD-810E.

(e) The ensemble outer garment, boots, gloves and helmet shall be capable of repeated toxic chemical decontamination procedures using neutralizing and absorbing chemicals and water spray.

(f) Electromagnetic Compatibility and Frequency Spectrum Assignment. Helmet RF systems shall be compatible with existing CCAS and VAFB crash/fire net frequency assignments.

(g) Safety Parameters.

1. The combined fire fighting/HAZMAT ensemble with body cooling and reservicing system must be safe to store and use throughout their life cycle.

2 A safety hazard analysis must be conducted IAW MIL-STD-882C and MIL-STD-1472D to include, but not limited to, hazards inherent in the design, testing and operational employment of the ensemble garment components, body cooling system and reservicing system.

(2) Security.

(a) Owner/user security applies IAW AFI 31-209. Security is provided by the facility/property protection standards associated with each location where the combined fire fighting/HAZMAT ensemble with body cooling and reservicing components are stored and employed. Additional security considerations are not required.

(b) A program protection plan for the ensemble system, if required, will be developed IAW AFD 31-7.

(c) Operational Security Plan. Operational security will be conducted IAW AFI 10-1101.

(3) Electronic Counter-Countermeasures. Not applicable.

(4) Software Engineering. Not applicable.

5. Integrated Logistics Support. An ILSP is not required. Existing logistics support for fire fighter protective equipment shall be applied to the ensemble.

a. Maintenance Planning. Existing logistics support for fire fighter protective equipment and SCBA shall be applied. No additional logistics support is required.

(1) All components of the body cooling system and mobile reservicing must be easily assembled, installed and maintained. Existing tools, test measurement and diagnostic equipment (TMDE), and/or presently approved, emerging TMDE or support equipment will be used.

(2) Specialized tools, if required, will be supplied with the ensemble system or reservicing units.

(3) The combined fire fighting/HAZMAT ensemble with body cooling and reservicing system shall be designed for ease of maintenance and resupply. All components must be designed for cost effectiveness, supportability and minimization of required logistics or maintenance resources.

(4) An ILS Plan shall be prepared. As a part of this Plan, a logistics support analysis (LSA) must be prepared to identify the necessary taskings and information to ensure proper system design, integration and configuration management.

(5) Maintenance Concept

a Maintenance and repair will be accomplished at the fire department or facility support O&M organizational level. Periodic inspections and preventive maintenance tasks will be programmed to ensure operational status.

b The level of replacement shall be at the major component level.

c The level of repair shall include only manufacturer-identified components or subsystems. All other items shall be repaired by replacement.

(6) Maintenance Requirements For On- and Off-Equipment Maintenance. TBD.

(7) Time-Phased Depot Requirements. Not Applicable.

(8) Organic Support Capabilities. TBD

(9) Depot Tasks and Capabilities Required. None.

b. Support Equipment (SE).

(1) Standard Support Equipment. The need for SE must be minimized, and is expected to be required for body cooling and reservicing unit components only. If SE is required, it must be designed so that it can be maintained using, to the maximum extent possible, existing tools and test equipment already in the USAF inventory.

(2) Depot level Support Equipment. Not applicable.

(3) Test and Fault Isolation Capabilities. If new SE and test equipment are required, it must be of minimum size, weight and complexity needed to verify system performance within specified limits. It also must unambiguously isolate malfunctions. Probabilities of detection and confidence levels are TBD.

c. Human Systems Integration (HSI):

(1) Operational And Maintenance Training Concept.

Initial training for operation and maintenance shall be by system technical data and on-site manufacturer training/technical support. No additional training support is required.

(2) Manpower, Personnel And Training Constraints. No additional manpower is required for training, maintenance or employment. Additional manpower to support system O&M is not required.

(3) Operational equipment shall be used for training.

(4) Human Performance/Human-In-Loop Issues.

(a) Using Command.

1. Manpower, Personnel, Training, Safety, Human Factors Engineering, and Health Hazards Constraints.

a The SCBA/body cooling reservicing unit will be designed for ease and speed of lifting/carrying and field operation from fire or HAZMAT vehicle mountings. It will be designed for ease of component removal for inspection or repair.

b IAW DODI 5000.2/AF Sup 1, MIL-STD 1472D, and MIL-STD-882C, a system safety analysis is required as a part of this development effort to ensure all tasks associated with the donning, doffing, maintenance and

use of the ensemble, and the operation and maintenance of the reservicing unit can be performed by all personnel. Particular attention should be given to hazard analyses for both testing and operational use and support of these systems in toxic chemical vapor, liquid splash and fire threat environments.

c The combined fire fighting/HAZMAT ensemble with body cooling and reservicing system must not present undesirable or uncontrolled ergonomic hazards to personnel, nor will it create any hazards from its configuration or the materials of construction used.

d The combined fire fighting/HAZMAT ensemble with body cooling and reservicing system both as individual components and as an integrated system worn by fire fighters, must be highly flexible and not impede fire fighter dexterity and mobility.

e The ensemble helmet and reflectorized outer garment must present the least possible impediment to the wearer's vision. Distortion and haze must be minimized. The visor must be fog-resistant.

f The combined fire fighting/HAZMAT ensemble with body cooling will maintain a fire fighter body core temperature of 100 °F or less while engaged in moderate-to-heavy activity with full breathing air at 90 °F ambient for a minimum of one hour. A 2-hour body cooling and SCBA capability is desirable.

2. Maintenance and Training Concepts.
Described in Paragraph 5c.

(b) Supporting Command.

1 Manpower Requirements For Depot Maintenance, Engineering, and Material Management. None.

2 Depot Training Requirements. None.

(4) Participating Command Manpower Requirements.
Additional manpower is not required.

(5) Training and Training Support.

(a) Operational Training Tasks. To be determined by the CCAS and VAFB fire department training officers.

(b) Maintenance Training Tasks. To be determined by the CCAS and VAFB fire department or by facility O&M support contractor fire extinguisher

maintenance technicians. Determinations shall be made in cognizance of the ensemble component manufacturer's technical support data on system operation, maintenance and repair and DT&E/IOT&E data.

(c) Training Support For Required
Operational Capabilities and Maintenance Requirements.
None.

(d) Airspace and Range Training
Requirements. Not applicable.

d. Computer Resources. Not Applicable.

e. Other Logistics Considerations.

(1) Supply Support.

(a) The combined fire fighting/HAZMAT ensemble with body cooling shall not require special storage or storage equipment.

(b) Equipment and spares identified in the repair-level analysis must be obtained and stocked at the appropriate levels, as part of the initial acquisition contract IAW AFI 10-602. Bench stock will be provided in unit type codes, if systems are identified for mobility requirements. A support/consumable spares kit will be provided with each ensemble, if required. Spares provisioning will be accomplished within 90 days after systems pass first article acceptance testing.

(c) CCAS and VAFB fire departments will be provisioned for ensemble components and for the reservicing systems through standard USAF logistics channels. No special supply support will be required.

(d) Replacement quantities shall be added to the CCAS and VAFB facility O&M organizational/contract bench stock systems, in accordance with the shelf life and maintenance specifications of the manufacturers and training use expenditure rates.

(e) Packaging, Handling and Transportation (PH&T).

1. PH&T requirements must be developed and implemented IAW the AFI 24-series directives. Requirements will be consistent with the program schedule and will be interfaced with other ILS elements.

2. Ensemble and body cooling garments, and the SCBA back pack will be containerized so they will not be adversely affected by prolonged storage under any climatic conditions.

3. Components shall be packaged so they will not be adversely affected by prolonged storage under any climatic conditions.

(f) Preservation, packing and packaging for ensemble components shall be designed to commercial fire fighter/HAZMAT ensemble protective equipment industry standards and shall provide the degree of protection and handling provisions necessary based on the characteristics of the item and its source, destination, storage and mode of transportation. Similarly, preservation, packing and packaging for the reservicing unit shall be designed to provide protection and handling provisions based on commercial fire apparatus standards and specifications.

(g) Provisioning Strategy. Fire departments shall use normal USAF and/or base support O&M supply channels and procedures.

(2) Technical Data.

(a) Technical Orders (TO) will be developed IAW AFPD 21-3, MIL-STD-1790A, MIL-M-38784C, and TO 00-5-3. TOs required for operation and maintenance of the system will be procured during the integration/production phase of the acquisition program. TOs must be fully validated by the contractor and verified by the Air Force during IOT&E.

(b) Technical manuals for operating and maintaining the body cooling system and reservicing unit will be provided by the manufacturer. These manuals and other related technical data will be fully validated by the Air Force during IOT&E.

(c) Production drawings and component schematics of the SCBA/body cooling and reservicing systems shall be provided.

(3) Facilities And Land. The combined fire fighting/HAZMAT ensemble with body cooling and SCBA reservicing units will be stored in existing CCAS and VAFB fire department bench stock areas, fire department apparatus storage areas, and inside fire department HAZMAT response vehicles.

(4) Logistics Support Analysis (LSA). Requirements are TBD.

(5) Hazardous Materials.

(a) Developers of improved combined fire fighting/HAZMAT ensemble with body cooling shall minimize the use of toxic or hazardous chemicals to produce the required performance characteristics. As a goal, no toxic or hazardous chemicals shall be used.

(b) The SCBA reservicing unit construction will minimize the use of hazardous materials in production. Magnesium and magnesium alloys shall not be used.

(6) Computer-Aided Acquisition Logistics Support (CALS). Requirements are TBD.

(7) Supporting Command Requirements.

(a) Additional Depot Facilities. None required.

(b) Special Handling, Storage and Transportation Requirements. None required.

(c) Engineering Data and Rights. Proprietary ownership of the combined fire fighting/HAZMAT ensemble with body cooling is anticipated and may be retained by the respective component or component materials manufacturers.

(d) Depot and System Technical Order Requirements.

1 No depot-level TOs are required.

2 System TOs governing the operation and maintenance of the body cooling system and mobile reservicing unit will be provided by the manufacturer. Specific TO requirements are TBD.

(e) Disposal of Hazardous Waste. Not applicable.

(f) Special Force Management Concepts. Not applicable.

(g) Plans For Advanced technology. Not Applicable.

(h) Configuration Control Concepts. TBD.

(i) Spares Strategies. LRU spares for the ensemble components and reservicing units will be provided at the base/unit/base support O&M contractor level.

(j) Sustaining Engineering. Engineering support shall be provided by the prime contractors selected to manufacture the ensemble components and reservicing unit.

(k) System Warranties and Guaranties.

1 The combined fire fighting/HAZMAT ensemble with body cooling shall include a manufacturer's warranty for specified performance during its guaranteed shelf life period that is easily administered and is consistent with the agent/foam/additive's performance specifications.

2 The SCBA reservicing unit shall include a manufacturer's warranty that is easily administered and is consistent with the system maintenance concept.

3 Warranties must be cost-beneficial and include the selected essential performance requirements. The development and approval of the warranty plan must be accomplished not later than 6 months after the award of the contract for engineering and manufacturing development.

4 Warranty Administration. The body of the warranty must describe, in detail, the specific requirements to administer the warranty. The administration section of the warranty plan will identify the administrative requirements. This section also must identify and assign responsibilities for processing warranty claims, for item disposition from CCAS/VAFB to the manufacturer chemical production for disposal. The administration plan also must describe the exact method of determining non-compliance with additive performance specifications and/or shelf life deterioration. It is essential that the selected operational performance and shelf life requirements defined in the contract specifications be measurable by standard USAF data collecting systems to prevent the warranty from being unmeasurable and, consequently, unenforceable.

5 Warranty Policy. DOD policy is to obtain only warranties that are cost-effective. Cost-benefit analysis methodologies must be used and a summary of the results provided to AFSPC/CE to determine if the proposed warranty is cost-effective and to provide the documentation necessary to process a waiver, should the warranty not be cost-effective.

(l) Environmental Stress Screening. Not Applicable.

(m) Postfielding Data Collection Efforts. TBD.

(8) Information Needs. No special or additional directives or forms are required to support the addition of ensemble or reservicing unit system components to the USAF supply inventory.

6. Infrastructure Support And Interoperability.

a. Command, Control, Communications And Intelligence. Not Applicable.

b. Transportation And Basing.

(1) The containers holding the combined fire fighting/HAZMAT ensemble with body cooling components will be air, land and sea transportable; compatible with the 463L pallet system; and capable of movement by theater distribution systems.

(2) The SCBA reservicing unit will be air, land and sea transportable; compatible with the 463L pallet system; and capable of movement by theater distribution systems.

c. Standardization, Interoperability, And Commonality.

(1) The ensemble and reservicing units will be ergonomically compatible with DOD fire fighting vehicles and equipment.

(2) Joint Potential Designation. TBD.

The ensemble and reservicing units will be commercially available for purchase by any DOD, other federal and municipal fire service organization.

d. Mapping, Charting And Geodesy Support. Not Applicable.

e. Environmental Support. Not Applicable.

7. Force Structure.

a. The combined fire fighting/HAZMAT ensemble with body cooling and the SCBA reservicing unit will be authorized for CCAS and VAFB fire departments. If joint USAF command sponsorship is enacted, these systems will be authorized to all fire departments with a HAZMAT emergency response mission.

b. CCAS and VAFB fire department response to hypergolic propellant fire, rescue and/or HAZMAT release incidents will be in accordance to the strict, controlled procedures defined in NFPA 471, *Recommended Practice For*

Responding To Hazardous Materials Incidents. In such circumstances, site entry into the hazardous ("hot") zone generally is conducted by small teams of 2 to 4 fire fighters, with an equal number at the ready to assist them. Once team members have completed operations or reached breathing air limits, they are decontaminated by additional fire fighter personnel in full Level A protection (standard HAZMAT Level A ensembles can be used for this purpose, since proximity fire protection is not required).

c. This CONOPS generates the requirement for 12 ensembles and 6 spares each at both CCAS and VAFB, for a Air Force Space Command total requirement of 36 units. Two SCBA reservicing units are required per base. One unit per base will be located in the fire station. The other will be installed on a HAZMAT response vehicle.

d. The required ensemble will provide increased HAZMAT and HAZMAT-involved fire and rescue response capabilities over the existing inventory ensembles at non-AFSPC active AF, ANG and AFR installations. Similarly, Army, Navy and Marine Corps fire service units may select the required ensemble for installation and/or shipboard HAZMAT emergency response. The total required number of systems is TBD.

8. Schedule Considerations:

a. IOC/FOC will be attained upon delivery of the required initial inventory of combined fire fighting/HAZMAT ensembles with body cooling and SCBA reservicing units to CCAS and VAFB fire departments.

b. The development, testing and acquisition of the specified ensemble components and reservicing units are urgently required to permit safe and effective fire fighting and rescue operations at CCAS and VAFB in the event of a significant hypergolic propellant release, fire and or personnel rescue requirement.

c. Required IOC Date: FY 98.

2 Atch

1. Requirements Correlation Matrix
2. Hazard Scenario Summary

REQUIREMENTS CORRELATION MATRIX						
PART I						
As Of Date:						
SYSTEM CAPABILITIES AND CHARACTERISTICS	ORD I		ORD II		ORD III	
	Thresholds	Objectives	Thresholds	Objectives	Thresholds	Objectives
1. Proximity Heat Protection *	5 minutes @ 3,000 °F	5 minutes @ 3,000 °F				
2. Liquid Chemical Resistance *	Hypergolic Propellants & Air Base HAZMAT Chemicals	Hypergolic Propellants & Air Base HAZMAT Chemicals				
3. Fire Fighter/HAZMAT Component Performance/Qualification Standards *	NFPA 1991 NFPA 1992 NFPA 1972 NFPA 1976 NFPA 1973 NFPA 1981 NFPA 1971	NFPA 1991 NFPA 1992 NFPA 1972 NFPA 1976 NFPA 1973 NFPA 1981 NFPA 1971				
4. Body Cooling System *						
a. Heat Removal	400 watts/hr	550 watts/hr				
b. Cooling Output Variability	Controlled By Wearer	Controlled By Wearer				
c. Configuration/Mobility	Self-Contained	Self-Contained				
d. Body Coverage	Head, Torso, Biceps, Thighs	Head, Torso, Biceps, Thighs				
e. Duration	1 Hour	2 Hours				

Note 1: An * Denotes An Item To Be Placed In The APB As A Key Parameter

1

FFHAZRCM

REQUIREMENTS CORRELATION MATRIX

PART I

As Of Date:

SYSTEM CAPABILITIES AND CHARACTERISTICS	ORD I		ORD II		ORD III	
	Thresholds	Objectives	Thresholds	Objectives	Thresholds	Objectives
5. SCBA System *	1 Hour	2 Hours				
	< 35 Pounds	< 35 Pounds				
	< 60 Pounds	< 60 Pounds				
	8 Inches or Less	8 Inches or Less				
6. Helmet Communications *						
a. Voice Projection	NFPA 1981	NFPA 1981				
b. Radio Interface	Compatible w/FF Hand-Held Radios	Compatible w/FF Hand-Held Radios				
7. Visibility *	120 Degrees Unobstructed Field Of Vision	120 Degrees Unobstructed Field Of Vision				
8. Ensemble Human Factors *	5 - 95 Percentile	5 - 95 Percentile				
	No Interference w/Fire Suppression, Rescue & HAZMAT Tasks	No Interference w/Fire Suppression, Rescue & HAZMAT Tasks				
a. Fit						
b. Firefighter Dexterity/Flexibility						

Note 1: An * Denotes An Item To Be Placed In The APB As A Key Parameter 2

FFHZRCM2

REQUIREMENTS CORRELATION MATRIX

PART I

As Of Date:

SYSTEM CAPABILITIES AND CHARACTERISTICS	ORD I		ORD II		ORD III	
	Thresholds	Objectives	Thresholds	Objectives	Thresholds	Objectives
9. SCBA Reservicing System * a. Installation/Location b. SCBA & Body Cooling Resupply c. Electrical Power Supply	Fire Station & HAZMAT Vehicle 5 Minutes or Less 110/120 VAC 50 & 60 Cycle	Fire Station & HAZMAT Vehicle 5 Minutes or Less 110/120 VAC 50 & 60 Cycle				

Note 1: An * Denotes An Item To Be Placed In The APB As A Key Parameter 3

FFHAZRCM3

REQUIREMENTS CORRELATION MATRIX
Part II

(Supporting Rationale for System Characteristics and Capabilities)

AS OF DATE:

Parameter 1 - Proximity Heat Protection. Defines the level of heat protection required to conduct fire department operations in the proximity of a hypergolic propellant fire. The fire departments at Cape Canaveral Air Station, Florida (CCAS) and at Vandenberg Air Force Base, California (VAFB) are the only two units in the USAF that must be equipped and trained to respond to accidental releases and fires involving very large quantities of highly toxic hypergolic fuels, hydrazine and its derivatives, and nitrogen tetroxide, a hypergolic oxidizer. Hydrazines burn at a flame spread rate that is about 10 times as fast as a hydrocarbon fuel fire. These fires are more intense and spread faster. Nitrogen tetroxide, the oxidizer propellant, is not flammable. However, when added to a fire, it enriches the fire intensity of combustion and burning rate by providing an additional oxygen source.

Parameter 2 - Liquid Chemical Resistance. Defines the specific chemicals that the ensemble fabrics must resist without penetration and exposure to the wearer. CCAS and VAFB fire fighters urgently need specifically designed personal protective equipment (PPE) for fire fighting operations involving exposure to the highly toxic liquid and vapor effects of hypergolic propellants. These chemical mixtures can be deadly and are extremely dangerous. Hydrazines are extremely toxic by inhalation and skin contact routes. Nitrogen tetroxide is extremely toxic, and presents a serious health risk through skin and eye contact, and inhalation routes. It reacts with skin moisture and with water in the lungs to produce nitric and nitrous acids that destroy contacted tissues.

Parameter 3 - Fire Fighter/HAZMAT Ensemble Component Performance and Qualification Standards. Defines the National Fire Protection Association (NFPA) standards for system and material performance to ensure fire fighter safety during fire fighting, rescue and HAZMAT response emergency operations. The standards are for chemical vapor and liquid protective suits, helmets, heat resistant suits for proximity fire fighting, SCBA, and gloves.

Parameter 4 - Body Cooling System Performance Standards.

Defines the required heat removal capacity, cooling output control, and mobility, body coverage and cooling duration requirements of the body cooling system to be worn under the flame and chemical protective ensemble garments. Existing fire fighter and HAZMAT ensembles provide no external source for body cooling. This limits fire fighter productivity and capability for strenuous tasks, such as fire fighting and rescue operations, to about 15 to 20 minutes of continuous operations, because of dehydration and heat exhaustion effects.

Parameter 5 - SCBA System Performance Standards. These criteria define the weight and shape limitations for the SCBA system. Breathing air duration requirements also are specified.

Parameter 6 - Helmet Communications Requirements. The helmet voice projection system must comply with the specified NFPA standard. The helmet radio interface must be compatible with current inventory fire department hand-held radio units.

Parameter 7 - Ensemble Component Visibility . Ensemble components, individually, and collectively, must provide the wearer with a minimum of 120 degrees of unobstructed vision. These components include the SCBA face plate, the encapsulated HAZMAT suit face plate, the helmet and the reflectorized outer garment.

Parameter 8 - Ensemble human factors. These criteria define ensemble fit and wearer dexterity requirements. Ensemble components must be designed to permit the accomplishment of strenuous fire fighter tasks without interference or impediment.

Parameter 9 - SCBA Reservicing System. These criteria define the performance and electrical power compatibility requirements for the portable SCBA reservicing unit.

CCAS/VAFB HYPERGOLIC PROPELLANT HAZARD SCENARIO SUMMARY

RELEASE SITUATION	RELEASE MECHANISM	MATERIAL RELEASED	CREDIBLE RELEASE (GAL)		FIRE DEPARTMENT CONSEQUENCES
			MINOR	MAJOR	
PROPELLANT SAMPLING ACCIDENT	OVERFILLED/DROPPED SAMPLE FLASK HOSE/CONNECTION LEAK	N2O4 N2H4 A-50 MMH	0.03	0.25	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
PROPELLANT CONTAINER/TANKER MAINTENANCE ACCIDENT	UNDETECTED RESIDUAL RELEASED DURING TEAR-DOWN	N2O4 N2H4 A-50 MMH	0.25	0.25	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
ROADWAY TRANSPORTATION VEHICLE ACCIDENT W/ CONTAINERS OR TRAILERS	WELD BREAK WALL PENETRATION LEAKING CONNECTION STEM	N2O4 N2H4 A-50 MMH	7.5 - 12.0	55 - 120	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
DROPPED CONTAINER - LOADING/UNLOADING ACCIDENT	WELD BREAK WALL PENETRATION LEAKING CONNECTION STEM	N2O4 N2H4 A-50 MMH	7.5	12.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
ROADWAY VEHICLE ACCIDENT W/GLASS & HOKE BOTTLE SAMPLES	BROKEN GLASS BOTTLE LEAKING HOKE BOTTLE	N2O4 N2H4 A-50 MMH	0.25	1.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
TRANSPORTATION OR PAY-LOAD MATING ACCIDENT W/ FUELED SATELLITE	SHOCK-INDUCED LEAK FUEL TANK PENETRATION	N2O4 N2H4 MMH	7.5	12.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
BULK HYPERGOL STORAGE TANK LOAD OR OFFLOAD ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.27	CCAS 200	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			7.34	VAFB 300	
LAUNCH VEHICLE FHA/OHA/UT FUEL/DEFUEL ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.84	DELTA 40	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			23.13	TITAN 400	
PAYLOAD PROCESSING FACILITY INCIDENT DURING SATELLITE FUELING/TESTING	CONNECTION LEAK MINOR HOSE FAILURE	N2O4 N2H4 MMH	0.06	1.0	FUEL SPILL RESPONSE OXIDIZER SPILL RESPONSE

PORTABLE PROPELLANT CONTAINER SUMMARY

- | | |
|--|------------------------------------|
| ● 55 GAL DRUMS (LEAST SAFE) | ● VAFB/VENDOR 5,000 GAL TANKERS |
| ● KSC 5/30 GAL DOT/ASME DRAIN CONTAINERS | ● KSC 500 GAL GPTU |
| ● SA-ALC 2,000 LB CYLINDERS | ● KSC/VENDOR 2,500 GAL TANKERS |
| ● PROGRAM-SPECIFIC GSE CARTS | ● 10,000 GAL RAIL CARS (MOST SAFE) |

ORDATCH2

APPENDIX B

**DRAFT OPERATIONAL REQUIREMENTS DOCUMENT (ORD)
FOR AN
INCIPIENT LEAK HYDRAZINE VAPOR DETECTION SYSTEM**

**OPERATIONAL REQUIREMENTS DOCUMENT (ORD) FOR AN
INCIPIENT LEAK HYDRAZINE VAPOR DETECTION SYSTEM**

1. General Description of Operational Capability:

a. Space vehicle launch and payload processing facilities at Cape Canaveral Air Station, Florida (CCAS) and at Vandenberg Air Force Base, California (VAFB) support all major United States Air Force (USAF) and commercial satellite space launch operations. These facilities support systems and processes that involve the storage and transfer of highly flammable, explosive and toxic hydrazine fuels.

b. Hydrazine-based fuels are found in very large bulk quantities only at CCAS and VAFB. Hydrazine also is used in small quantities at bases supporting F-16 and B-2 APU systems. Anhydrous Hydrazine, AH (N_2H_4), and its derivatives, monomethylhydrazine, MMH (CH_6N_2), unsymmetrical dimethylhydrazine UDMH ($C_2H_8N_2$), and Aerozine 50 (A-50), a 50:50 percent mixture of AH and UDMH, are extremely toxic by inhalation and skin contact routes. They spontaneously and violently react when contacted with oxides, such as rust, dust and debris, vapor or spark.

c. CCAS and VAFB technicians are involved in several hazardous processes where reliable and rapid detection of hydrazine vapors will be essential in preventing major propellant release incidents with consequences of serious injury or death, and the potential for significant facility and environmental damage. These include:

(1) Loading/unloading 2,500 gallon mobile tankers at bulk storage facilities.

(2) Propellant fuel (A-50) off-load at Titan IV ready storage sites.

(3) Titan IV Stage I & II A-50 fueling from on-site ready storage tanks. Delta Stage II launch vehicle A-50 fueling operations are from 2,500 gallon mobile tanker trailers.

(4) Satellite fueling (N_2O_4 & MMH) operations in ground-level or launch tower clean room facilities and Centaur fueling in launch tower clean rooms.

d. Fires fueled by Anhydrous Hydrazine and its derivatives are virtually smokeless and emit little or no visible radiation. Technicians involved in hypergolic propellant fuel operations wear fully-encapsulated protective ensembles. These include vision-restricting helmets and face plates. Because of the near-invisible

nature of hydrazine vapors and limited fields of vision, these personnel have extreme difficulties in identifying the location and size of a hydrazine fire, its rate of growth, and direction of spread. Therefore, technician proximity to a hydrazine fire can remain undetected until a very dangerous secondary effect is recognized - the melting of the individual's protective ensemble components.

e. In such cases, these very dangerous conditions can lead to ineffective use of portable fire extinguishers, delayed or ineffective emergency actions and evacuation to include system shutdown and sounding alarms, as well as technician injury or death. Thus, it is imperative that hydrazine/fuel vapors be detected early, before explosive levels can build up, and before fuel liquid and/or vapors can come into contact with any material that will cause ignition or detonation to take place.

f. Therefore, CCAS and VAFB facilities and processes with hydrazine hazards urgently need an automatic vapor detection system that can reliably detect hydrazine and hydrazine derivative vapors at the leak source during the incipient stage of the release process and warn personnel to take corrective action. Given this advanced notice, preventive measures can be initiated to identify, isolate and terminate the leak condition, before the release quantity is sufficient to support combustion or vapor phase explosion. Early incipient leak detection and emergency actions to prevent or mitigate the release of highly toxic and explosive hydrazine fuels combine to form a very capable and effective method of fire and explosion prevention.

g. This ORD is in direct support of the Air Force Space Command's Mission Need Statement (MNS), AFSPC XX-YY, ----- (There may be 1 MNS for military space lift support and a different one for commercial support.) This(These) MNS is/are in direct support of OUSD (A) Mission Area (s) XXX, YYY-----.

h. The Requirements Correlation Matrix (RCM) for a hydrazine vapor detection system is at Attachment 1.

2. Threat:

a. Accidental hydrazine fuel liquid or vapor releases at CCAS and VAFB require rapid, reliable detection and the sounding of electronic, visible and audible alarms to enable immediate technician emergency actions to prevent a far more serious event. The lead time afforded by incipient vapor detection can be used to prevent or mitigate the build up of explosive vapors and/or the contact of hydrazine with a combustion source. In this manner, hydrazine vapor detection systems can significantly reduce the potential for loss of life and property following an accidental release

and fire during hydrazine transfer and/or container maintenance operations.

b. Hazard analyses were conducted to determine the mechanisms and locations of accidents or incidents on CCAS and VAFB that would involve the release of propellant fuels. Accidental releases of hypergolic propellants on CCAS and VAFB were assumed to result from incidents involving propellant containers, mobile tanker-trailers, and/or the transfer equipment used to pump and distribute the commodities from one container to another, or into the launch vehicle and payload on-board tanks. The potential fixed facility locations where such accidents were most likely to occur were determined by mapping the receipt, storage and end-use distribution flow chart-histories of hydrazine fuels on CCAS and VAFB.

c. Three facility-related accidental hypergolic chemical release hazard scenarios resulting from common space launch system processing and support operations at CCAS and VAFB were identified. These scenarios represent the generalized hydrazine fuel vapor and potential fire/explosion threats facing at CCAS and VAFB in fixed facilities where the installation of an incipient vapor detection system is technically feasible, and can significantly improve process and life safety. They are:

(1) Propellant transfer accident at bulk storage facilities.

(2) Propellant release accident during launch vehicle fueling or defueling operations.

(3) Accidental release during propellant transfer operations in payload processing facility clean rooms.

d. In each of these scenarios, four release mechanisms are assumed: (1) Improper seating or failure of connection hardware of stainless steel flexible transfer hose sections, (2) Minor material failure of stainless steel flexible hose section, such as a small tear, split or rupture. (3) Major material failure of stainless steel flexible hose during propellant transfer operation or Propellant Transfer Unit component material failure. (4) Improper routing of propellant under pressure via fixed and flexible connections between the transfer unit, the donor tank (s), the receiving tank and/or associated peripheral systems.

e. Attachment 2 provides a summary of these hydrazine incident scenarios, the corresponding expected hydrazine release quantities and fire threat consequences.

f. "Sabotage Threat To USAF Space Launch Facilities. (A specific threat dealing with CCAS and VAFB terrorist threats & sabotage involving hypergolic propellant storage tank or transfer vehicles or the launch vehicles at the pads?).

g. "Threat Compendium, Worldwide Threat To Air Bases: 1991-2001", 31 Dec 91. Provides descriptions of the systems, weapons, and organizations representing an air- and land-based threat to USAF Bases. (Note: the terrorist threat to CCAS & VAFB may be contained in this document. If so, cite this document in both paragraph c & d).

3. Shortcomings of Existing Systems:

a. Hydrazine is very explosive at concentration within a very wide range of explosive limits (2.5% - 98% for MMH) and burns at a rate that is about 10 times as fast as a hydrocarbon fuel fire. It is more intense and spreads faster. Additionally, hydrazine fires are virtually colorless and smokeless. This is because the carbon-based compounds that are contained in and produced by jet or automotive fuel fires are not present in hydrazines to produce black smoke and the characteristic yellow-orange vapor. Therefore, it is imperative to detect hydrazine leaks at the earliest possible stage of development, during their incipient state when detectable quantities are in the 1 to 25 parts per million (ppm) concentration range.

b. Current hydrazine sensors are capable of detecting vapor levels associated with major leaks and spills and for detecting explosive concentrations. They are marginally capable of detecting hydrazine vapor concentrations locations needed for incipient (1 -25 ppm) leak detection and rapid emergency response, and may require lengthy sampling times for a single detection point. Furthermore, current fixed point area hydrazine detection systems are not capable of the sequential monitoring of multiple potential leak points, as is required for incipient leak detection of specific fuel transfer hardware configurations.

4. Capabilities Required. The space launch organizations at CCAS and VAFB require the development and acquisition of a hydrazine and hydrazine derivative vapor detection system for interior and exterior (outdoor) use at propellant transfer and storage facilities and inside payload processing clean rooms.

a. System Performance:

(1) Performance Parameters. The hydrazine vapor detection system is envisioned to be a family of detection systems or a system that can be calibrated to react to vapors from each of the hydrazine fuel types, and to take

into account the various site-specific chemical background false alarm sources.

(a) Clean Room Hydrazine Vapor Detection.

The hydrazine vapor detection system will identify a 1 to 25 ppm (ORD II should specify the required ppm detection level) vapor concentration of anhydrous hydrazine or MMH vapor produced by a calibrated laboratory release simulation apparatus at a 1-ft range under interior USAF ground-level and launch tower clean room equipment, chemical background and ventilation air flow conditions. Anhydrous hydrazine and MMH are typical fuels for military and commercial satellite payloads and Centaur reaction control systems. The detection system shall support a minimum of 8 sampling locations. Sampling shall be sequential from one location at a time. Response time for each sampling location shall be 2 minutes or less.

(b) A-50 Bulk Transfer & Storage Facility Vapor Detection. The hydrazine vapor detection system will identify a 1 to 25 ppm (ORD II should specify the required ppm detection level) vapor concentration from a calibrated laboratory release simulation apparatus at a 1-ft range under outside/exterior CCAS and VAFB fuel storage and transfer facility background weather conditions TBD. Large quantities of A-50 are stored in bulk and transported in mobile trailers to fuel Titan and Delta launch vehicles. The detection system shall support a minimum of 8 sampling locations. Sampling shall be sequential from one location at a time. Response time for each sampling location shall be 5 minutes or less. The system shall be environmentally and impact-hardened for both fixed and portable field/facility applications.

(c) Hydrazine vapor detection systems shall not react/alarm to any background chemicals associated with space launch system, facility or payload cleaning, maintenance or fueling operation.

(d) Hydrazine vapor detection systems shall not react/alarm to any electromagnetic energy sources associated with space launch system communications or surveillance equipment, or from any transient energy that may be associated with CCAS or VAFB space launch support operations.

(e) System detection of hydrazine vapors shall result in the initiation of area visible and audible alarms/klaxons and the transmission of an alarm status message to both the CCAS/VAFB fire department and one or more TBD launch squadron command and control centers. Alarm hardware and message transmission electronics shall be detection system component subsystems. Alarm messages shall be transmitted by TBD (RF and/or hard wire) data links.

(2) SEEK EAGLE Requirements. Not Applicable.

b. Logistics and Readiness:

(1) Operational Availability.

(a) Clean Room Systems. Hydrazine vapor detection systems in clean rooms shall demonstrate a system availability of 99 percent over a mission time of two years.

(b) Exterior/Outdoor Systems. Hydrazine vapor detection systems protecting outdoors or other non-fully enclosed processes and/or equipment shall demonstrate a system availability of 97 percent over a mission time of two years.

(c) These levels of availability are attainable with appropriate system design considerations of circuit modularity, BIT, and maintenance engineering.

(2) Expected Maintenance and Manpower Skill Levels. Hydrazine vapor detection systems shall require no increase in Civil Engineering Electronics Control (AFSC XXXXX) or facility support contractor personnel equivalent manpower. The system shall be maintainable by 3- and 5-skill level technicians. Manufacturer's contract maintenance and CCAS/VAFB launch support contractor maintenance options shall be considered during system life cycle cost analysis and acquisition approach planning.

(3) Logistics Supportability And Readiness Requirements.

(a) Hydrazine vapor detection systems will be logistically-supportable by CCAS and VAFB base supply organizations and systems. Contract maintenance is TBD.

(b) Hydrazine vapor detection systems shall be operable and maintainable under the CCAS and VAFB design climactic conditions of temperature, humidity, rain, and sea salt spray for exterior electronic systems.

(c) The hydrazine vapor detection system Mean Time To Repair (MTTR) to reinstate it to full operational status after a fault warning shall not exceed 4 hours.

(d) Hydrazine vapor detection systems shall allow 100% fault detection and/or isolation, remove/replace and checkout using self-test or manual procedures with standard Base Civil Engineer (BCE) and/or launch support facility contractor tools and/or common support equipment.

(e) Hydrazine vapor detection systems shall be designed with self-diagnostic checks on all electronic system components. Systems shall initiate a trouble/fault alarm via RF or hard wire link to the CCAS/VAFB launch control command center TBD, whenever the any component is not functioning according to design specifications. Furthermore, the systems shall contain visual and audible alarm components that activate in the "trouble" mode to alert personnel that automatic vapor detection may not be functioning. The frequency of automatic internal checks and status reports to command centers and fire departments shall be 15 minutes.

c. Critical System Characteristics

(1) Mandatory Characteristics.

(a) Expected Mission Capability. Hydrazine vapor detection systems will be installed in clean rooms and other launch support facilities that support hypergolic fuel transfer and storage operations. Multiple detectors will be installed to insure all hazard areas are contained within the system's hydrazine vapor detection performance boundaries, as specified in Paragraph 4a(1). System detection of hydrazine vapors shall result in the initiation of area visible and audible alarms/klaxons and the transmission of an alarm status message to the CCAS/VAFB launch squadron command and control centers.

(b) Electronic Counter-Countermeasures (ECCM) and Wartime Reserve Modes (WARM) Requirements. Not Applicable.

(c) Conventional, Initial Nuclear Weapons Effects, Nuclear, Biological, and Chemical Survivability. Not Applicable.

(d) Environmental Factors. Hydrazine vapor detection systems must be capable of reliable, continuous operation under the climactic conditions associated with CCAS and VAFB weather statistics.

1 Systems must be able to operate in temperatures ranging from -10 °F to +140 °F.

2 Systems must incorporate appropriate environmental storage control systems and fabrication materials to prevent system damage from cold, heat, humidity or thermal expansion.

3 Materials used in the fabrication of systems will not support the growth of fungi to the best commercial practices.

4 System performance capabilities will not be adversely affected by wind-blown dust, sand or sea salt spray. Cleaning maintenance schedules for exposed detector heads/optics shall be developed to account for these expected outside use conditions.

5 System components will withstand the UV effects of sunlight with minimal material degradation for the system service life.

6 Environmental requirements for weather seals, air tightness, humidity, marine atmosphere, low temperature, temperature shock, heat transfer, blowing sand, dust, UV effects, solar loads and water tightness shall be IAW MIL-STD-810E.

(e) Electromagnetic Compatibility and Frequency Spectrum Assignment.

1 Hydrazine vapor detection systems shall not adversely react to electromagnetic energy emissions associated with space launch ground support, payload processing or on-board satellite communications/telemetry systems.

2 New RF communications frequencies are not required. Systems shall use the currently-assigned RF operating frequencies of the fire department alarm systems and of the launch/processing control centers for each launch system at CCAS and VAFB.

(f) Safety Parameters.

1. Electromagnetic energy emissions from hydrazine vapor detection systems shall not present a hazard to space systems, aircraft or air crews operating from or near CCAS or VAFB.

2. The use and maintenance of the hydrazine fire detection systems shall be prescribed in documented procedures for hazardous dynamic transfer and system configuration operations and the surveillance of unattended hypergolic fuel storage and transfer systems. Procedures shall be based on the results of MIL-STD-882C system safety hazard analyses for each potential system application/location.

(2) Security. Owner/user security applies IAW AFI 31-209. Security is provided by the facility/property protection standards associated with each location where hydrazine vapor detection systems are installed and the security classification of the launch vehicle and payload systems. Additional security considerations are not required.

(3) Electronic Counter-Countermeasures. Not applicable.

(4) Software Engineering. TBD.

5. Integrated Logistics Support. An ILSP is not required. Existing logistics support for commercial vapor detection systems shall be applied. No additional logistics support is required.

a. Maintenance Planning. All components of hydrazine vapor detection systems must be easily assembled, installed and maintained. Existing tools, test measurement and diagnostic equipment (TMDE), and/or presently approved, emerging TMDE or support equipment will be used. Specialized TMDE or tools, if required, will be supplied with the system equipment.

(1) Maintenance and repair will be accomplished at the facility support O&M organizational level or by manufacturer contract maintenance. Periodic inspections and preventive maintenance tasks will be programmed to ensure operational status.

(2) The level of replacement shall be at the major component level.

(3) Maintenance Requirements For On- and Off-Equipment Maintenance. TBD.

(4) Time-Phased Depot Requirements. Not Applicable.

(5) Organic Support Capabilities. TBD

(6) Depot Tasks and Capabilities Required. None.

b. Support Equipment.

(1) Standard Support Equipment. Hydrazine vapor detection systems will be self-contained and require no additional support equipment.

(2) Depot level Support Equipment. Not applicable.

(3) Test and Fault Isolation Capabilities.

(a) Hydrazine vapor detection systems shall maximize the use of built-in test equipment to negate the need for redundant SE, isolate the faulty system modules, and determine system availability for use.

(b) System level fault isolation will identify the major component at 100 percent for organizational replacement and/or repair.

(c) Systems must notify the supporting fire department and operational control center (s) of a malfunction with an audible and visible status signal.

c. Human Systems Integration (HSI):

(1) Operational And Maintenance Training Concept. Initial training for the operation and maintenance of hydrazine vapor detection systems shall be by system technical data and on-site manufacturer training/technical support. No additional training support is required.

(2) Manpower, Personnel And Training Constraints. No additional manpower is required for training, maintenance or employment of the hydrazine vapor detection system.

(3) Human Performance/Human-In-Loop Issues.

(a) Using Command.

1. Manpower, Personnel, Training, Safety, Human Factors Engineering, and Health Hazards Constraints. None.

2. Maintenance and Training Concepts. Described in Paragraph 5c.

(b) Supporting Command. No depot manpower or training requirements are identified.

(4) Participating Command manpower Requirements. Not applicable.

(5) Training and Training Support.

(a) Operational training Tasks. To be determined by manufacturer technical data.

(b) Maintenance Training Tasks. To be determined by manufacturer technical data.

(c) Training Support For Required Operational Capabilities and Maintenance Requirements. To be determined by manufacturer technical data.

(d) Airspace and Range Training Requirements. Not applicable.

d. Computer Resources. Not Applicable.

e. Other Logistics Considerations.

(1) Supply Support.

(a) Hydrazine vapor detection system components shall not require special storage or storage equipment.

(b) Repair/replacement items for hydrazine vapor detection system components shall be added to the CCAS and VAFB facility O&M organizational/contract bench stock systems, in accordance with the initial purchase contract specifications with the manufacturer. CCAS and VAFB maintenance organizations will be provisioned through standard USAF or contractor logistics channels. No special supply support will be required.

(c) Equipment and component spares will be identified in a repair-level analysis, and will be purchased and stocked as a part of the initial purchase contract IAW AFI 10-602.

(d) Packaging, Handling and Transportation (PH&T).

1. PH&T requirements must be developed and implemented IAW the AFI 24-series directives. Requirements will be consistent with the program schedule and will be interfaced with other ILS elements.

2. Hydrazine vapor detection system and/or components will be designed and packaged to withstand expected shocks of transportation and handling IAW MIL-STD-810E.

3. Systems and system components shall be packaged so they will not be adversely affected by prolonged storage under any climactic conditions.

(e) Preservation, Packing and Packaging for system components shall be designed to commercial fire detector industry standards and shall provide the degree of protection and handling provisions necessary based on the characteristics of the item and its source, destination, storage and mode of transportation. System components shall use preservation, packaging and packing methods and materials currently in use by the commercial fire detector industry.

(f) Provisioning Strategy. Hydrazine vapor detection systems shall be supplied/stocked through normal USAF and/or facility O&M support contractor supply channels and procedures.

(2) Technical Data.

(a) Technical manuals for operating and maintaining Hydrazine vapor detection systems and system components will be provided by the manufacturer. These manuals and other related technical data will be fully validated by the Air Force during a demonstration by the manufacturer of an initial prototype system installation at CCAS or VAFB.

(b) Technical manuals shall include an appropriate technical and functional description of the system and its components. Data shall include system installation, operation and maintenance, refurbishment of detectors, RF transmitters and logic controllers. Logic controller software and detector calibration/sensitivity data also shall be fully documented.

(c) Production drawings and electrical schematics shall be provided.

(3) Facilities And Land.

(a) Hydrazine vapor detection systems will be installed in/on existing CCAS and VAFB hydrazine fuel storage areas, transfer location and clean room facilities.

(b) Hydrazine vapor detection system spare components will be stored in existing CCAS and VAFB supply warehouses and fire department bench stock areas.

(4) Logistics Support Analysis (LSA). Preparation of a LSA is not anticipated.

(5) Hazardous Materials. Hydrazine vapor detection system design and construction will minimize the use of hazardous materials in production. Magnesium and magnesium alloys shall not be used.

(6) Computer-Aided Acquisition Logistics Support (CALs). Requirements are TBD.

(7) Supporting Command Requirements.

(a) Additional Depot Facilities. None required.

(b) Special Handling, Storage and Transportation Requirements. None required.

(c) Engineering Data and Rights. Proprietary hardware ownership is anticipated and may be retained by the manufacturer. However, ownership of the source plans should revert to the Government in the event

the owner discontinues the product line or ceases to exist. The Government should have the right to purchase the hardware source plans.

(d) Depot and System Technical Order Requirements. None required.

(e) Disposal of Hazardous Waste. Not applicable. Hydrazine vapor detection system components should not contain or produce hazardous waste.

(f) Special Force Management Concepts. Not applicable.

(g) Plans For Advanced technology. Not Applicable.

(h) Configuration Control Concepts. TBD.

(i) Spares Strategies. System component spares will be provided and stored at the base/O&M support contractor level.

(j) Sustaining engineering. Engineering support shall be provided by the manufacturer for the life of the system.

(k) System Warranties and Guaranties. The hydrazine vapor detection system shall include a manufacturer's warranty that is easily administered and is consistent with the system maintenance concept. It must be cost-beneficial and include the selected essential performance requirements. The use of this warranty must be transparent to the user's operation and maintenance of the system. The development and approval of the warranty plan must be accomplished not later than 6 months after the award of the contract for engineering and manufacturing development.

1 Warranty Administration. The body of the warranty must describe, in detail, the specific requirements to administer the warranty. The administration section of the warranty plan will identify the administrative requirements. This section also must identify and assign responsibilities for processing warranty claims, for item disposition from CCAS/VAFB to the manufacturer's repair facility, and the return of the warranted item to the supply system. The administration plan also must describe the exact method of determining failures, including the manual or automated system used to accomplish warranty tracking efforts. It is essential that the selected operational performance requirements defined in the contract specifications be measurable by standard USAF

data collecting systems to prevent the warranty from being unmeasurable and, consequently, unenforceable.

2 Warranty Policy. DOD policy is to obtain only warranties that are cost-effective. Cost-benefit analysis methodologies must be used and a summary of the results provided to AFSPC/CE to determine if the proposed warranty is cost-effective and to provide the documentation necessary to process a waiver, should the warranty not be cost-effective.

(1) Environmental Stress Screening. TBD.

(m) Postfielding Data Collection Efforts.
TBD.

(8) Information Needs. No special or additional directives or forms are required to support the addition of this detection system to the USAF supply inventory.

6. Infrastructure Support And Interoperability.

a. Command, Control, Communications And Intelligence. Hydrazine vapor detection systems shall include an alerting capability to notify the launch/payload operational control center (s) of system activation or malfunction.

b. Transportation And Basing. Hydrazine vapor detection systems and components shall be land and air transportable via the commercial package express industry.

c. Standardization, Interoperability, And Commonality.

(1) Hydrazine vapor detection system components will be compatible with standard 120 VAC/60 Hz electrical power sources available or others to be specified at the CCAS and VAFB facilities where use is planned.

(2) Joint Potential Designation. TBD with NASA KSC facilities and processes.

d. Mapping, Charting And Geodesy Support. Not Applicable.

e. Environmental Support. Not Applicable.

7. Force Structure. Exact design configurations at CCAS and VAFB are TBD. A preliminary estimate of minimum Air Force requirements is:

a. CCAS.

(1) Fuel Storage Area #1.

(a) Mobile Tanker Hydrazine Storage Area

(b) Hypergolic Stockpile Storage Facility (HSSF) transfer apron area.

(2) All ground-level and MST/launch tower payload processing facility clean rooms.

(3) SLC 40/41 Titan IV Fuel Handling Areas

(4) SLC 17 A/B Delta Stage II A-50 fueling vehicle/support equipment areas.

b. VAFB.

(1) Hypergolic Stockpile Storage Facility (HSSF).

(a) Mobile Tanker Hydrazine Load/Offload Area

(b) Fuel storage tank clusters/containment areas.

(2) All ground-level and MST/launch tower payload processing facility clean rooms.

(3) SLC 4E/W Titan IV Fuel Handling Areas

(4) SLC 2 E/W Delta Stage II A-50 fueling vehicle/support equipment areas.

8. Schedule Considerations:

a. IOC/FOC will be attained upon delivery of the required initial inventory of hydrazine vapor detection systems are installed and performance validated at the CCAS and VAFB facilities/locations defined in Paragraph 7.

b. Required IOC Date: FY 97.

2 Atch

1. Requirements Correlation Matrix
2. Hazard Scenario Summary

REQUIREMENTS CORRELATION MATRIX

PART I

As Of Date:

SYSTEM CAPABILITIES AND CHARACTERISTICS	ORD I		ORD II		ORD III	
	Thresholds	Objectives	Thresholds	Objectives	Thresholds	Objectives
1. Clean Room Vapor Detection: N2H4 & MMH *	1-25 ppm at 6-in Range	1-25 ppm at 6-in Range				
2. A-50 Bulk Storage & Transfer Facility Flame Detection *	1-25 ppm at 12-in Range	1-SF Pan Fire At 100-Ft Range				
3. Number of Leak Point Sampling Locations *	8	8				
4. Detector Response Time For Each Sampling Location *	2 Minutes	2 Minutes				
5. False-Alarm Immunity *	Clean Room & Storage Site Background Chemicals RF Emissions EMP	Clean Room & Storage Site Background Chemicals RF Emissions EMP				
6. Alarms *	Area Audible & Visible Remote Digital	Area Audible & Visible Remote Digital				

Note 1: An * Denotes An Item To Be Placed In The APB As A Key Parameter

VAPORRCM

REQUIREMENTS CORRELATION MATRIX
Part II

(Supporting Rationale for System Characteristics and Capabilities)

AS OF DATE:

Parameter 1 - Clean Room Vapor Detection Sensitivity. These threshold parameters define the concentration of the hydrazine and MMH and the maximum range at which it must be detected for acceptable vapor detection system performance in clean room applications.

Parameter 2 - Outdoor A-50 Bulk Storage & Transfer Facility Vapor Detection Sensitivity. These threshold parameters define the concentration the A-50 and the maximum range at which it must be detected for acceptable vapor detection system performance in outdoor facility applications.

Parameter 3- Number of Sampling Locations. Defines the minimum number of discrete sampling points that can be addressed by the vapor detection system. They, normally, would correspond to fuel transfer hardware connection points.

Parameter 4 Detector System Response Time. This parameter defines the maximum permissible time period between the initiation of a 1 -25 ppm concentration at a potential leak point and the alarm message to the defined control centers by the system logic controller and/or RF transmitter. Within this time period the hydrazine vapor detection system must recognize and confirm the presence of an actual vapor threat, and not a false alarm source.

Parameter 5 - False Alarm Immunity. This criterion defines the possible false alarm stimuli to which the hydrazine vapor detection system must not react. Detectors must be immune to both single and multiple false alarm sources associated with interior and exterior propellant transfer operations.

Parameter 6 - Alarms. This criterion defines the audible, visible and digital alarms that must be generated upon detection of hydrazine vapors at or above the defined threshold concentration.

CCAS/VAFB HYPERGOLIC PROPELLANT HAZARD SCENARIO SUMMARY

RELEASE SITUATION	RELEASE MECHANISM	MATERIAL RELEASED	CREDIBLE RELEASE (GAL)		FIRE DEPARTMENT CONSEQUENCES
			MINOR	MAJOR	
BULK HYPERGOL STORAGE TANK LOAD OR OFFLOAD ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.27	CCAS 200	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			7.34	VAFB 300	
LAUNCH VEHICLE FHA/OHA/UT FUEL/DEFUEL ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.84	DELTA 40	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			23.13	TITAN 400	
PAYLOAD PROCESSING FACILITY INCIDENT DURING SATELLITE FUELING/TESTING	CONNECTION LEAK MINOR HOSE FAILURE	N2O4 N2H4 MMH	0.06	1.0	FUEL SPILL RESPONSE OXIDIZER SPILL RESPONSE

PORTABLE PROPELLANT CONTAINER SUMMARY

- | | |
|--|------------------------------------|
| ● 55 GAL DRUMS (LEAST SAFE) | ● VAFB/VENDOR 5,000 GAL TANKERS |
| ● KSC 5/30 GAL DOT/ASME DRAIN CONTAINERS | ● KSC 500 GAL GPTU |
| ● SA-ALC 2,000 LB CYLINDERS | ● KSC/VENDOR 2,500 GAL TANKERS |
| ● PROGRAM-SPECIFIC GSE CARTS | ● 10,000 GAL RAIL CARS (MOST SAFE) |

ORDATH2B

APPENDIX C

DRAFT OPERATIONAL REQUIREMENTS DOCUMENT (ORD)
FOR A
HYDRAZINE FIRE FIGHTING AGENT LUMINESCENCE ADDITIVE

**OPERATIONAL REQUIREMENTS DOCUMENT (ORD) FOR A
HYDRAZINE FIRE-FIGHTING AGENT LUMINESCENCE ADDITIVE**

1. General Description of Operational Capability:

a. The fire departments at Cape Canaveral Air Station, Florida (CCAS) and at Vandenberg Air Force Base, California (VAFB) are the only two units in the USAF that must be equipped and trained to respond to accidental releases and fires involving very large quantities of highly toxic hydrazine fuels. Their mission is to provide structural, crash, rescue, and fire prevention capabilities for the launch support facilities, space launch vehicles, payloads, and hazardous propellant storage and transfer facilities involved in United States Air Force (USAF) and commercial satellite launch operations. Hydrazine-based fuels are used in small quantities at bases supporting F-16 and B-2 APU systems, however, special fire fighting agent requirements have not been identified.

b. CCAS and VAFB fire department emergency response operations to hydrazine fuel release incidents or accidents involve exposure to the combined flame and highly toxic liquids and vapor effects of this hypergolic propellant. Anhydrous Hydrazine, AH (N_2H_4), and its derivatives, monomethylhydrazine, MMH (CH_6N_2), unsymmetrical dimethylhydrazine UDMH ($C_2H_8N_2$), and Aerozine 50 (A-50), a 50:50 percent mixture of AH and UDMH, are extremely toxic by inhalation and skin contact routes. They spontaneously and violently react when contacted with oxides, such as rust, dust and debris, flame or spark.

c. Fires fueled by Anhydrous Hydrazine and its derivatives are virtually smokeless and emit little or no visible radiation. The essential visual signatures for effective fire suppression and rescue operations involving a "normal" hydrocarbon fire are missing. Therefore, responding CCAS and VAFB fire fighters will have extreme difficulties in identifying the location and size of a hydrazine fire, its rate of growth and direction of spread. Firefighter proximity to a hydrazine fire may remain undetected until very dangerous secondary effects are recognized, such as an extreme temperature rise, the combustion of nearby materials and/or the melting of the individual's protective ensemble components. Such dangerous conditions could lead to ineffective fire extinguishment and/or fire fighter injury or death.

d. CCAS and VAFB fire fighters urgently need a chemical that can be added to fire and vapor suppression agents (water, foams, dry chemicals, etc.) that will react with hydrazines or hydrazine flames to produce visible flame

and smoke. Preferably, the additive would cause hydrazines to burn with a visible flame and produce a recognizable smoke plume. Alternatively, the additive would produce an independent colored flame and smoke, as a result of its combustion within the hydrazine fire.

e. This ORD is in direct support of the Air Force Space Command's Mission Need Statement (MNS), AFSPC XX-YY, ----- (There may be 1 MNS for military space lift support and a different one for commercial support.) This(These) MNS is/are in direct support of OUSD (A) Mission Area (s) XXX, YYY-----.

d. This ORD also supports Air Combat Command (ACC) MNS CAF 311-90, New Generation of Fire Fighting and Crash Rescue Systems, which identifies the need for improved fire detection and fire fighting agents.

e. The Requirements Correlation Matrix (RCM) for a hydrazine fire fighting agent luminescence additive is at Attachment 1.

2. Threat:

a. The primary causes of hypergolic chemical release and ignition at CCAS and VAFB that would require fire fighter suppression and rescue response are accidents during lift vehicle and payload processing operations. These normally occur during the transfer of propellant chemicals from bulk or mobile storage containers into a launch vehicle or payload on-board fuel tank. Hazard analyses were conducted to determine the mechanisms and locations of accidents or incidents on CCAS and VAFB that would involve the release of hypergolic propellants and, consequently, trigger a fire department emergency response. Accidental releases of hypergolic propellants on CCAS and VAFB were assumed to result from incidents involving propellant containers, mobile tanker-trailers, and/or the transfer equipment used to pump and distribute the commodities from one container to another, or into the launch vehicle and payload on-board tanks. The potential locations where such accidents were most likely to occur were determined by mapping the receipt, storage and end-use distribution flow chart-histories of hydrazine fuels and nitrogen tetroxide on CCAS and VAFB.

b. Nine accidental hypergolic chemical release hazard scenarios resulting from common space launch system processing and support operations at CCAS and VAFB were identified. These scenarios represent a spectrum of generalized hypergolic chemical/fire threats facing the CCAS and VAFB Fire Departments. Each can generate a fire department requirement to provide fire suppression, rescue

and/or HAZMAT emergency response, or a combined fire-HAZMAT operation. They are:

(1) Accident during propellant storage container sampling operation. The release mechanisms are over-filled glass sample bottles, dropped glass sample bottles, and the improper seating of sample draw equipment connections.

(2) Accident during propellant container or mobile tanker maintenance. The propellant is released when an access port or container penetration component at or near the bottom of the container is removed with residual chemical remaining. This causes the gravity flow of the propellant on to the pavement or ground below.

(3) Roadway vehicle accident involving propellant containers or tanker-trailers. The release mechanism is assumed to be a puncture or break in the portable hypergolic propellant container or tank that results from damage sustained in a transportation vehicle accident.

(4) Loading or unloading accident involving a dropped propellant container. A puncture or break in a portable hypergolic propellant container is assumed to result from damage sustained in a container loading/off-loading accident.

(5). Vehicle accident involving propellant sample containers. Assumed release mechanisms are broken glass sample bottles and/or damaged Hoke bottles. Exterior carrier containers are assumed to have broken open. The propellants are assumed to be released at the accident site.

(6) Transportation or mating accident involving a fueled satellite payload. Two primary release mechanisms are assumed. The first is caused by impact or shock to the payload propellant system from the accident situation. This would then cause a break or material failure (such as at a weld or pipe connection) in a tank or distribution line. The second mechanism is assumed to be a penetration of a propellant tank by another rigid object. In both cases, propellant would escape under pressure to the surrounding area. The propellant could be contained within the satellite's transportation shroud or be could be released to the open air in a clean room or outdoor accident site.

(7) Propellant transfer accident at bulk storage facilities. Three release mechanisms are assumed: (a) Improper seating or failure of connection hardware of stainless steel flexible transfer hose sections, (b) Minor material failure of stainless steel flexible hose section, such as a small tear, split or rupture. (c) Major material

failure of stainless steel flexible hose during propellant transfer operation or Propellant Transfer Unit component material failure.

(8) Propellant release accident during launch vehicle fueling or defueling operations. Release mechanisms and volumes are identical to those defined in the previous sub-paragraph for bulk storage facility propellant transfer accidents.

(9) Accidental release during propellant transfer operations in payload processing facility clean rooms. Assumed release mechanisms are: (a) Improper seating or failure of connection hardware of stainless steel flexible transfer hose sections, and, (b) Material failure of stainless steel flexible hose section, such as a small tear, split or rupture.

Attachment 2 provides a summary of these hydrazine incident scenarios, the corresponding expected hydrazine release quantities and fire threat consequences.

c. "Sabotage Threat To USAF Space Launch Facilities. (A specific threat dealing with CCAS and VAFB terrorist threats & sabotage involving hypergolic propellant storage tank or transfer vehicles or the launch vehicles at the pads?).

d. "Threat Compendium, Worldwide Threat To Air Bases: 1991-2001", 31 Dec 91. Provides descriptions of the systems, weapons, and organizations representing an air- and land-based threat to USAF Bases. (Note: the terrorist threat to CCAS & VAFB may be contained in this document. If so, cite this document in both paragraph c & d).

3. Shortcomings of Existing Systems:

a. Background Data On Hydrazine Fires & Fire Department Response Capabilities:

(1) Hydrazine burns at a rate that is about 10 times as fast as a hydrocarbon fuel fire. Therefore, it is more intense and spreads faster.

(2) Hydrazine fires are virtually colorless and smokeless. This is because the carbon-based compounds that are contained in and produced by jet or automotive fuel fires are not present in hydrazines to produce black smoke and the characteristic yellow-orange flame. There are no smoke and flame warning mechanisms "built in" at the fire scene to alert the fire fighter that he/she is about to enter the very intense and dangerous fire plume, itself.

(3) The CCAS and VAFB fire departments are equipped to fight hydrazine fires with crash vehicles and pumpers. The crash vehicles carry from 1,000 to 3,000 gallons of water/Aqueous Film-Forming Foam (AFFF) on board. Pumpers may carry 500 gallons of water and normally rely on hydrant connections to provide hose streams for fire extinguishment.

(4) Initial fire department response to a CCAS or VAFB hydrazine fire incident will, normally, rely on AFFF application by mobile crash vehicles, until hydrant-fed hand lines can be established. Then joint AFFF-water application can be considered by the on-scene senior fire officer. During the initial minutes of the response, the sole fire fighting capability will be the agent contained in the crash vehicle on-board tanks (1,000 - 3,000 gallons). Crash vehicle turret application rates are from 500 to 750 gallons per minute (GPM). Therefore, only a very few minutes of fire extinguishment time are available early-on for agent application on the fire.

b. Hydrazine Fire Response Scenario. Combining the factors described in subparagraph a, the following scenario results to depict the significant shortcomings of the existing system:

(1) Fire fighters responding to a hydrazine or hydrazine derivative fire will have to deal with an almost invisible fire that produced little or no smoke. They will have extreme difficulty in determining where the fire boundaries are, the total fire size and the rate of fire spread. Unless there is an eyewitness account, it will be very difficult to pinpoint the source of the released fuel and the flow mechanism, such as gravity-fed or pressurized leaks. Application of AFFF from initial response vehicles may be very ineffective, since target range and position will be very difficult to judge without visual fire signatures. Once on-board stores of AFFF are expended, vehicles must return to a water source for resupply, or must be connected to a fire hydrant, which may or may not be available. During delays in agent application, reignition from hot metal surfaces or fire burn-back from foam decay can occur, or secondary fires involving collateral materials, vehicles or facilities may be ignited by the hydrazine fire. "Invisible" pockets of hydrazine fires will continue to burn until permanently extinguished or until the fuel source is depleted.

(2) Fire fighters on foot will be placed in additional danger, since they will not enjoy crash vehicle insulating safety and escape speed. With no smoke or flame coloration danger signals, fire fighters may impinge on the fire surface before they realize its location. The danger is compounded, since the fire fighters will not be aware of

fire spread direction or rate caused by wind conditions or fuel flow. Note: Hydrogen fires also are colorless and smokeless. Workers in hydrogen refineries hold straw brooms out in front of them to locate suspected fires: when the broom ignites, one fire boundary is located.

(3) Rescue attempts will be similarly dangerous. Fire fighters can unexpectedly enter a fire area they did not know was there on their way to or from a rescue site with or without a rescue victim in tow. Because of the usually windy conditions associated with the California and Florida coastal locations of USAF launch sites, such a situation would be extremely dangerous for larger fires in the 100 - 400 gallon or larger range.

(4) In summary, CCAS and VAFB fire fighters, today, must fight a hydrazine fuel fire almost "blindly" using current inventory fire fighting agents and equipment. This places the fire fighter in increased jeopardy, and significantly increases the fire loss risk to launch site facilities and, possibly, the launch vehicle and payload systems. Hydrazine fire consequences will depend on the location of the hydrazine release point relative to launch systems or facilities, the speed and accuracy of fire identification and fire department response, and the effectiveness of fire fighting agent application by fire fighters in vehicles and at the end of hose lines.

4. Capabilities Required. The fire departments at CCAS and VAFB require the development and acquisition of a chemical luminescence additive that when mixed with a fire fighting agent and applied to a hydrazine fire surface will: (1) cause hydrazine and its derivatives to burn with recognizable smoke and visible coloration signatures, (2) react with a hydrazine flame to produce recognizable smoke and visible coloration signatures, or, (3) preferably, do both.

a. System Performance:

(1) Performance Parameters.

(a) The hydrazine luminescence additive will react on contact with or mix with hydrazine and hydrazine derivative fuels to produce a resultant mixture or compound that burns with a flame and smoke plume that are clearly visible under bright sunlight outdoor weather conditions. Visible smoke density and flame intensity requirements are:

1. Smoke Particle Criteria: TBD
2. Flame Spectral Criteria: TBD

(b) Hydrazine luminescence additives are required for both water-based and dry chemical current inventory fire extinguishing agents.

1. The hydrazine luminescence additive for water-based fire extinguishing agents will be compatible and miscible with water and AFFF (NSN-----).

2. The hydrazine luminescence additive for dry chemical-based fire extinguishing agents will be compatible and miscible with Sodium Bicarbonate (NSN-----) and Potassium Bicarbonate (NSN-----) agent formulations.

3. The hydrazine luminescence additive for dry chemical-based fire extinguishing agents will not be susceptible to moisture absorption and/or caking inside the extinguisher or hose line to produce restricted or blocked flow.

(c) The hydrazine luminescence additive for water-based agents, water and AFFF, will be added to the water component of the agent, only. It may not be added to the AFFF storage tank on USAF crash response vehicles. The required additive concentration in water to produce the specified smoke and flame coloration signatures shall be 5 percent by volume, or less.

(d) The required additive concentration in dry chemical extinguishers to produce the specified smoke and flame coloration signatures shall be 5 percent by weight, or less.

(e) The hydrazine luminescence additive will produce the specified smoke density and flame intensity characteristics throughout the full range of operational temperatures associated with the effective application of the host agents. Required operating temperature ranges are:

1. For water: from + 34 to 140 °F.
2. For AFFF: from + 34 to 140 °F.
3. For dry chemical agents: from TBD to 140 °F.

(f) The hydrazine luminescence additive for both water-based and dry chemical agents will not produce, or cause to produce, toxic vapors while in its neat form or when mixed with water or dry chemical agent prior to its application to the hydrazine fire source.

(g). The hydrazine luminescence additive for both water-based and dry chemical agents will produce, or cause to produce, combustion products with minimum human toxicity. Hydrazine vapors and combustion products are extremely toxic. The objective is for the luminescence additive, when introduced to a hydrazine fire, to produce smoke and other combustion products that are no more toxic than the combustion products associated with the water, AFFF or dry chemical extinguishment of a hydrocarbon fuel fire (JP-4, JP-8 & AVGAS).

(2) SEEK EAGLE - Requirements. Not Applicable.

b. Logistics and Readiness:

(1) Operational Availability. The hydrazine luminescence additive for both water-based and dry chemical agents will have a storage shelf life of 5 years or greater.

(2) Expected Maintenance and Manpower Skill Levels. Not Applicable.

(3) Logistics Supportability And Readiness Requirements.

(a) The hydrazine luminescence additives will be logistically-supportable by CCAS and VAFB base supply organizations and systems.

(b) The required dry storage temperature range for hydrazine luminescence additives are:

1. Water-based agents: from + 34 to 140 °F.

2. Dry chemical agents: from - TBD to 140 °F.

(c) The hydrazine luminescence additive will be premixed in crash vehicle and pumper water storage tanks, and in hand-held or wheeled dry chemical extinguishers.

(d) Application of the hydrazine luminescence additive from hydrant-supplied pumper vehicles after on-board premix supplies have been expended shall be by eductor injection from the bulk supply container into the hose stream. The eductor system shall be designed for compatibility and ease of installation considering USAF fire vehicle apparatus and the additive's container configuration. The eductor shall inject the design proportions of the hydrazine luminescence additive (gallons/GPM) within +/- 10% of that specified.

(e) The maximum size of the hydrazine luminescence additive bulk container shall be 5 gallons for the liquid agent additive and 50 pounds for the dry chemical agent additive.

(f) The hydrazine luminescence additive will be compatible with fire fighting vehicle storage tank materials and the materials of the associated agent dispensing, hose and turret systems.

(g) The water-based hydrazine luminescence additive normally will be added to crash vehicle or pumper on-board water storage tanks only after the notification of a hydrazine fire incident has been received by the fire department. Fire chiefs will establish local policies and procedures for adding the additive chemical via field-filling operations directly from bulk supply containers (5 gallons or less). CCAS and VAFB fire chiefs may choose to premix the hydrazine luminescence additive in one or more fire fighting vehicles. However, any use of the vehicle's water supply for routine turret training or tank maintenance will result in the loss of the additive. Such losses will require makeup additive to be placed in the storage tank. Bench stock provisioning must be adjusted to account for these potential losses, if premixed vehicles are maintained.

(h) The container system for the hydrazine luminescence additive will include provisions for rapid field-filling of fire vehicle on-board water tanks under operational fire fighting conditions. Each container shall include a filling spout that can be rapidly attached to the main access port and an air vent port with removable cap. Hydrazine fire luminescence additive containers will be similar in design to portable, commercial 10-gallon gasoline tanks with built-in handles and telescoping or internally-stored pouring spouts and vent caps.

c. Critical System Characteristics

(1) Mandatory Characteristics.

(a) Expected Mission Capability. CCAS and VAFB fire fighters will premix the hydrazine luminescence additive with on-board crash vehicle and pumper water supplies and with portable extinguisher dry chemical agents. The luminescence chemical, when applied to hydrazine/hydrazine derivative fires as a constituent of a water, AFFF or dry chemical fire extinguishing agent, will result in the production of visible smoke and flame coloration signatures. These signatures will enable fire fighters to determine the hydrazine fire's location, size, and growth rate, and to effectively apply fire agents to extinguish the fire and effect rescue operations. For larger hydrazine fires requiring long duration sustained

agent application, injection of the luminescence additive into hand-held hose lines will be conducted using an eductor system connected to on-scene additive storage containers.

(b) Electronic Counter-Countermeasures (ECCM) and Wartime Reserve Modes (WARM) Requirements. Not Applicable.

(c) Conventional, Initial Nuclear Weapons Effects, Nuclear, Biological, and Chemical Survivability. Not Applicable.

(d) Environmental Factors. The hydrazine fire chemical luminescence additive will be capable of mixing with the delivery fire fighting agent and will produce the specified smoke and fire coloration signatures under all climatic and temperature conditions expected at CCAS and VAFB. Operational temperature ranges are:

1. For water: from + 34 to 140 °F.
2. For AFFF: from + 34 to 140 °F.
3. For dry chemical agents: from TBD to 140 °F.

(e) Electromagnetic Compatibility and Frequency Spectrum Assignment. Not applicable.

(f) Safety Parameters.

1. The hydrazine fire chemical luminescence additive must be safe to store and use throughout its life cycle.

2. The use of the hydrazine fire chemical luminescence additive as a component of a hydrazine fire extinguishing agent must not produce combustion products that are more toxic than those associated with the fire itself or the extinguishment process without the additive present.

(2) Security. Owner/user security applies IAW AFI 31-209. Security is provided by base level warehousing and fire department bench stock safeguarding procedures for fire fighting agents. Additional security considerations are not required.

(3) Electronic Counter-Countermeasures. Not applicable.

(4) Software Engineering. Not applicable.

5. Integrated Logistics Support. An ILSP is not required. Existing logistics support for fire extinguishing agents and chemicals shall be applied to the hydrazine luminescence additive. The eductor system required for hose stream additive injection does not require development, and shall be purchased from commercial fire apparatus vendors. No additional logistics support is required.

a. Maintenance Planning. The eductor system required for hose stream additive injection will have minimum or no maintenance requirements and must be easily assembled and used.

(1) Eductor system maintenance and repair will be accomplished by CCAS/VAFB fire department personnel at the fire station.

(2) Eductor system replacement shall be at the unit level.

(3) The level of repair shall repair by replacement.

(4) Maintenance Requirements For On- and Off-Equipment Maintenance. Not Applicable.

(5) Time-Phased Depot Requirements. Not Applicable.

(6) Organic Support Capabilities. Not Applicable.

(7) Depot Tasks and Capabilities Required. Not Applicable.

b. Support Equipment.

(1) Standard Support Equipment. An eductor system is required to enable hose stream additive injection. This is an equipment item with an estimated unit cost of less than \$1,000. It does not require development and shall be purchased from commercial fire apparatus vendors.

(2) Depot level Support Equipment. Not applicable.

(3) Test and Fault Isolation Capabilities. Not applicable.

c. Human Systems Integration (HSI):

(1) Operational And Maintenance Training Concept. Training for the addition of the luminescence additive to fire fighting vehicles and extinguisher systems, and for the

application of the additive as a constituent of a hydrazine fire fighting agent will be conducted by the CCAS and VAFB fire department training organizations. Performance and handling data to be used for training materials will be documented during the additives' development test and evaluation (DT&E). No additional training support is required.

(2) Manpower, Personnel And Training Constraints. No additional manpower is required for training, maintenance or employment of the hydrazine luminescence additive chemical.

(3) Human Performance/Human-In-Loop Issues.

(a) Using Command.

1. Manpower, Personnel, Training, Safety, Human Factors Engineering, and Health Hazards Constraints. The container for the water-based hydrazine fire chemical luminescence additive will be designed for ease and speed of lifting/carrying and field-filling into fire vehicle on-board water storage tanks with minimum spillage.

2. Maintenance and Training Concepts. Described in Paragraph 5c.

(b) Supporting Command. No depot manpower or training requirements are identified.

(4) Participating Command manpower Requirements. Not applicable.

(5) Training and Training Support.

(a) Operational training Tasks. To be determined by the CCAS and VAFB fire department training officers.

(b) Maintenance Training Tasks. None.

(c) Training Support For Required Operational Capabilities and Maintenance Requirements. None.

(d) Airspace and Range Training Requirements. Not applicable.

d. Computer Resources. Not Applicable.

e. Other Logistics Considerations.

(1) Supply Support.

(a) The hydrazine luminescence additive shall not require special storage or storage equipment.

(b) The hydrazine luminescence additive shall be added to the CCAS and VAFB fire fighting agent bench stock systems, in accordance with the chemical classification assigned following its final formulation, development and testing. CCAS and VAFB fire departments will be provisioned through standard USAF logistics channels. No special supply support will be required.

(c) Replacement quantities shall be added to the CCAS and VAFB facility O&M organizational/contract bench stock systems, in accordance with the shelf life specifications of the manufacturer and training use expenditure rates.

(d) Equipment and component spares. Not Applicable.

(e) Packaging, Handling and Transportation (PH&T).

1. PH&T requirements must be developed and implemented IAW the AFI 24-series directives. Requirements will be consistent with the program schedule and will be interfaced with other ILS elements.

2. The hydrazine fire chemical luminescence additive will be containerized so it will not be adversely affected by prolonged storage under any climatic conditions.

3. The container for the hydrazine fire chemical luminescence additive will include features for rapid field-filling of fire vehicle agent tanks IAW Paragraph 4b(7&8).

4. The hydrazine fire chemical luminescence additive will be packaged to withstand expected shocks of transportation and handling IAW MIL-STD-810E.

(f) Preservation, Packing and Packaging for the chemical additive formulation shall be designed to commercial fire extinguishing agent industry standards and shall provide the degree of protection and handling provisions necessary based on the characteristics of the item and its source, destination, storage and mode of transportation.

(g) Provisioning Strategy. Fire departments shall utilize normal USAF and/or base support O&M supply channels and procedures.

(2) Technical Data. Required technical data will include the chemical additive manufacturer's Material Safety Data Sheet (MSDS) and the additives' final DT&E Test Report.

(a) Technical data will be fully validated by the Air Force during a demonstration by the manufacturer of agent performance in live hydrazine fires conducted at the NASA hypergol fire training facility at CCAS.

(b) Technical data shall include appropriate mixing ratios for various application techniques, proper dispensing rates, areas of coverage per unit volume dispensed, and proper storage, handling and cleanup procedures.

(c) Technical data shall include an environmental assessment of the consequences of the additive agent when released to both air and ground environments.

(3) Facilities and Land. The hydrazine fire chemical luminescence additive will be stored in existing CCAS and VAFB supply warehouses and fire department bench stock areas.

(4) Logistics Support Analysis (LSA). Requirements are TBD, however, preparation of a LSA is not anticipated.

(5) Hazardous Materials. The hydrazine fire luminescence additive developer shall minimize the use of toxic or hazardous chemicals to produce the required luminescence performance characteristics. As a goal, no toxic or hazardous chemicals shall be used.

(6) The luminescence additive will minimize soil and ground water pollution. As a goal, it will be biodegradable.

(7) Computer-Aided Acquisition Logistics Support (CALS). Requirements are TBD.

(8) Supporting Command Requirements.

(a) Additional Depot Facilities. None required.

(b) Special Handling, Storage and Transportation Requirements. None required.

(c) Engineering Data and Rights. Proprietary ownership of the chemical formulation of the luminescence additive is anticipated and may be retained by the manufacturer. However, ownership of the formula should revert to the Government in the event the owner discontinues the product line or ceases to exist. The Government should have the right to purchase the additive chemical formula.

(d) Depot and System Technical Order Requirements. None required.

(e) Disposal of Hazardous Waste. TBD. The hydrazine luminescence additive will minimize the use of hazardous chemicals. Should the final formula be classified as hazardous, disposal shall be in accordance with existing CCAS and VAFB disposal by contract programs.

(f) Special Force Management Concepts. Not applicable.

(g) Plans For Advanced technology. Not Applicable.

(h) Configuration Control Concepts. Not Applicable.

(i) Spares Strategies. Not Applicable.

(j) Sustaining engineering. Engineering support shall be provided by the additive chemical manufacturer.

(k) System Warranties and Guaranties. The hydrazine fire luminescence additive shall include a manufacturer's warranty for specified performance during its guaranteed shelf life period that is easily administered and is consistent with the additive's performance specifications. It must be cost-beneficial and include the selected essential performance requirements. The development and approval of the warranty plan must be accomplished not later than 6 months after the award of the contract for engineering and manufacturing development.

1 Warranty Administration. The body of the warranty must describe, in detail, the specific requirements to administer the warranty. The administration section of the warranty plan will identify the administrative requirements. This section also must identify and assign responsibilities for processing warranty claims, for item disposition from CCAS/VAFB to the manufacturer chemical production for disposal. The administration plan also must describe the exact method of determining non-compliance with additive performance specifications and/or shelf life deterioration. It is

essential that the selected operational performance and shelf life requirements defined in the contract specifications be measurable by standard USAF data collecting systems to prevent the warranty from being unmeasurable and, consequently, unenforceable.

2 Warranty Policy. DOD policy is to obtain only warranties that are cost-effective. Cost-benefit analysis methodologies must be used and a summary of the results provided to AFSPC/CE to determine if the proposed warranty is cost-effective and to provide the documentation necessary to process a waiver, should the warranty not be cost-effective.

(1) Environmental Stress Screening. Not Applicable.

(m) Postfielding Data Collection Efforts. TBD.

(8) Information Needs. No special or additional directives or forms are required to support the addition of this chemical additive to the USAF supply inventory.

6. Infrastructure Support And Interoperability.

a. Command, Control, Communications And Intelligence. Not Applicable.

b. Transportation And Basing. The container holding hydrazine fire chemical luminescence additive will be land transportable.

c. Standardization, Interoperability, And Commonality.

(1) The hydrazine fire chemical luminescence additive will be compatible with DOD, other federal and municipal fire fighting vehicles and portable fire extinguishers worldwide.

(2) Joint Potential Designation. TBD. The additive will be commercially available for purchase by any DOD, other federal and municipal fire service organization with a hydrazine fire response mission requirement.

d. Mapping, Charting And Geodesy Support. Not Applicable.

e. Environmental Support. Not Applicable.

7. Force Structure.

a. Dry Chemical And Water-Based Additives Base Stock Level Requirements.

(1) The AFSPC ready storage purchase quantity of a selected additive shall be the amount to fully charge all selected fire department crash vehicles and/or delivery systems that will be employed in hypergolic fire fighting response at CCAS and VAFB.

(2) Additionally, each fire department shall store 3X this quantity at the unit bench stock location. Furthermore, each base supply warehouse shall store a like 3X quantity. Total on-base storage of agents/foams shall not be less than 6X the in-vehicle/system ready storage amount.

(3) The total initial quantity to be purchased is 7X the ready storage amount.

b. Water-Based Agents. The AFSPC initial purchase quantity of hydrazine fire luminescence additive for mixture with water in fire vehicle on-board tanks or for eductor injection into hand-held hose lines is 3,500 gallons, or 1,750 gallons each for CCAS and VAFB. The rationale for this quantity is as follows:

(1) Maximum hydrazine spill & fire involvement: 400 gallons

(2) Estimated maximum fire area (flat, smooth, continuous surface): 5,000 SF

(3) AFFF application rate (1960-1961 National Fire Code): 0.25 GPM/SF

(4) Estimated application rate total duration: 4 minutes.

(5) Total AFFF agent delivered: $5,000 \text{ SF} \times 0.25 \text{ GPM/SF} \times 4 \text{ Min} = 5,000 \text{ gallons.}$

(6) Maximum required luminescence agent concentration by volume with fire vehicle water supply: 5%.

(7) Required hydrazine fire luminescence additive ready storage volume:
 $5,000 \text{ gal} \times 0.05 = 250 \text{ gallons.}$ Use 50 five-gallon pails per base for initial hydrazine fire extinguishment operations.

(8) Per base total requirement = 7 X ready storage: 250 gallons + 3 X 250 gallons + 3 X 250 gallons = 1,750 gallons. Use 350 five-gallon pails per base.

(10) AFSPC initial purchase requirement: 3,500 gallons or 750 five-gallon pails.

(11) Estimated annual resupply quantity for training requirements only: Minimum 5% or 100 gallons. Bases that maintain fully premixed fire fighting vehicles will require increased replenishment quantities.

b. Dry Chemical Agents. The AFSPC initial purchase quantity of hydrazine fire luminescence additive for mixture in dry chemical fire extinguishers is 3,500 pounds, or 1,750 pounds each for CCAS and VAFB. The single base rationale for this quantity is as follows:

(1) Number of 20-pound, hand-held extinguishers requiring additive: 50

(2) Number of wheeled, 150-pound extinguishers requiring additive = 10

(3) Per base required quantity based on maximum 10% required concentration: $0.10 \times ([20 \times 50] + [150 \times 10]) = 250$ pounds.

(4) Per base total requirement = 7 X ready storage: 500 pounds + 3 X 500 pounds + 3 X 250 pounds = 1,750 pounds.

(5) AFSPC initial purchase requirement: 3,500 pounds.

(6) Annual replenishment quantities will vary with commercial fire extinguisher and USAF inspection and maintenance requirements. An agent replacement cycle of 4 years is assumed.

c. Other. The hydrazine fire luminescence additive will be authorized for all non-space mission support fire departments with a hydrazine fire threat.

8. Schedule Considerations:

a. IOC/FOC will be attained upon delivery of the required initial inventory of hydrazine fire luminescence additive quantities to CCAS and VAFB fire departments.

b. The development, testing and acquisition of the specified hydrazine fire luminescence additives urgently is required to permit safe and effective fire fighting and rescue operations at CCAS and VAFB in the event of a significant hydrazine fire.

c. Required IOC Date: FY 97.

2 Atch

1. Requirements Correlation Matrix
2. Hazard Scenario Summary

REQUIREMENTS CORRELATION MATRIX

PART I

As Of Date:

SYSTEM CAPABILITIES AND CHARACTERISTICS	ORD I		ORD II		ORD III	
	Thresholds	Objectives	Thresholds	Objectives	Thresholds	Objectives
1. Production of Visible Smoke and Coloration When Applied To Hydrazine Fire as a Fire Fighting Agent Additive*						
a. Smoke Particle Density	TBD	TBD				
b. Flame Spectral Output	TBD	TBD				
2. Chemical Compatibility With Water, AFFF, Sodium and Potassium Bicarbonate Dry Powder Agents and Fire Vehicle/Extinguisher Agent Storage and Delivery System Materials *	No Chemical Reaction	No Chemical Reaction				
3. Additive Concentration To Produce Threshold Smoke/Flame Signature Properties *						
a. Water-Based Agents	5% By Volume	3% By Volume				
b. Dry Chemical Agents	5% By Weight	3% By Weight				
4. Operational Temperature Range *						
a. Water	+34 - 140 °F	+34 - 140 °F				
b. AFFF	+34 - 140 °F	+34 - 140 °F				
c. Dry Chemical Agents	TBD - 140 °F	TBD - 140 °F				
5. Minimum Toxicity Combustion & Extinguishment Products In Hydrazine Fire	Minimum Toxicity Products	No Toxic Products				

Note 1: An * Denotes An Item To Be Placed In The APB As A Key Parameter

1

BROOMRCM

REQUIREMENTS CORRELATION MATRIX

PART I

As Of Date:

SYSTEM CAPABILITIES AND CHARACTERISTICS	ORD I		ORD II		ORD III	
	Thresholds	Objectives	Thresholds	Objectives	Thresholds	Objectives
6. Storage Shelf Life *	5 Years	10 Years				
7. Bulk Storage Container Requirements *						
a. Capacity: Liquid Agents	5 Gallons	5 Gallons				
b. Capacity: Dry Chemical Agents	50 Pounds	50 Pounds				
c. Rapid, Field Refill Hardware - Liquid Agents Only	Integral Pouring Spout & Air Vent	Integral Pouring Spout & Air Vent				

Note 1: An * Denotes An Item To Be Placed In The APB As A Key Parameter

2

BROMRCM2

REQUIREMENTS CORRELATION MATRIX
Part II

(Supporting Rationale for System Characteristics and Capabilities)

AS OF DATE:

Parameter 1 - Production of Visible Smoke and Coloration When Applied To Hydrazine Fire as a Fire Fighting Agent Additive. These signatures will enable fire fighters to determine the hydrazine fire's location, size, and growth rate, and to effectively apply fire agents to extinguish the fire and effect rescue operations. Since fires fueled by Anhydrous Hydrazine and its derivatives are virtually smokeless and emit little or no visible radiation and heat, responding CCAS and VAFB fire fighters will have extreme difficulties in conducting safe and effective fire fighting and rescue operations.

Parameter 2 - Compatibility With Water, AFFF, Sodium and Potassium Bicarbonate Dry Powder Agents and Fire Vehicle/Extinguisher Agent Storage and Delivery Systems. The hydrazine fire luminescence additive will be premixed with fire vehicle on-board water supplies and with the dry chemical charge in portable extinguishers. It must not react with either the water or dry chemical constituents of the fire fighting agent or with any of the materials of the agent storage tank, piping, hoses or nozzles associated with the agent delivery system. Reactions include those producing heat, altered properties of the host agent, corrosion and/or extinguisher material degradation.

Parameter 3 - Additive Concentration To Produce Threshold Smoke/Flame Signature Properties. The hydrazine fire luminescence additive most likely will not be a fire extinguishing chemical. Its addition to a fire vehicle or portable fire extinguisher agent storage tank will displace an equal volume of fire fighting agent. This will proportionally degrade the fire department's true/effective agent delivery rate (GPM) and the total volume of agent (Gallons) that can be applied to a hydrazine fire. Therefore, the additive concentration should be the minimum required to produce the required signatures, but no greater than the limits specified.

Parameter 4 - Operational Temperature Range. The hydrazine fire luminescence additive will be used to enhance hydrazine fire suppression and rescue operations at the USAF space launch and launch support facilities at Cape Canaveral Air Station (CCAS) and Vandenberg Air Force Base (VAFB). Since it will be premixed with the on-board water supplies of

crash vehicles or injected directly into hand-held water hose lines, the additive must be effective for water temperatures in the specified above freezing temperature range. Similarly, the dry chemical additive must remain effective over the entire performance range of this class of extinguishers, as specified.

Parameter 5- Minimum Toxicity Combustion & Extinguishment Products In Hydrazine Fires. Hydrazine vapors and combustion products are extremely toxic. Additional toxic materials are produced by the chemical and mechanical reactions associated with the extinguishment process. These gases and particulates produce hazards to fire fighters, personnel and wildlife in the path of the combustion products plume. It is desired that the hydrazine fire luminescence additive does not increase the amount of toxic products of a baseline fire that is extinguished by water or dry chemical agent alone.

Parameter 6 - Storage Shelf Life. A minimum 5 to 10-year storage shelf life is required to minimize life cycle cost and material supportability requirements.

Parameter 7 - Bulk Storage Container Requirements. The water-based hydrazine luminescence additive normally will be added to crash vehicle or pumper on-board water storage tanks only after the notification of a hydrazine fire incident has been received by the fire department. This will require a rapid fill capability to minimize response time to the hydrazine fire incident scene. Additional refills may be required after the initial water/additive supply has been expended on the fire. This fill action would be conducted at the fire response site. Therefore, the container system for the hydrazine luminescence additive will include provisions for rapid field-filling of fire vehicle on-board water tanks under operational fire fighting conditions. Each container shall include a filling spout that can be rapidly attached to the main access port and an air vent port with removable cap. Hydrazine fire luminescence additive containers should be similar in design to portable, commercial 10-gallon gasoline tanks with built-in handles and telescoping or internally-stored pouring spouts and vent caps.

CCAS/VAFB HYPERGOLIC PROPELLANT HAZARD SCENARIO SUMMARY

RELEASE SITUATION	RELEASE MECHANISM	MATERIAL RELEASED	CREDIBLE RELEASE (GAL)		FIRE DEPARTMENT CONSEQUENCES
			MINOR	MAJOR	
PROPELLANT SAMPLING ACCIDENT	OVERFILLED/DROPPED SAMPLE FLASK HOSE/CONNECTION LEAK	N2O4 N2H4 A-50 MMH	0.03	0.25	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
PROPELLANT CONTAINER/ TANKER MAINTENANCE ACCIDENT	UNDETECTED RESIDUAL RELEASED DURING TEAR-DOWN	N2O4 N2H4 A-50 MMH	0.25	0.25	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
ROADWAY TRANSPORTATION VEHICLE ACCIDENT W/ CONTAINERS OR TRAILERS	WELD BREAK WALL PENETRATION LEAKING CONNECTION STEM	N2O4 N2H4 A-50 MMH	7.5 - 12.0	55 - 120	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
DROPPED CONTAINER - LOADING/UNLOADING ACCIDENT	WELD BREAK WALL PENETRATION LEAKING CONNECTION STEM	N2O4 N2H4 MMH	7.5	12.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
ROADWAY VEHICLE ACCIDENT W/GLASS & HOKE BOTTLE SAMPLES	BROKEN GLASS BOTTLE LEAKING HOKE BOTTLE	N2O4 N2H4 A-50 MMH	0.25	1.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
TRANSPORTATION OR PAY-LOAD MATING ACCIDENT W/ FUELED SATELLITE	SHOCK-INDUCED LEAK FUEL TANK PENETRATION	N2O4 N2H4 MMH	7.5	12.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
BULK HYPERGOL STORAGE TANK LOAD OR OFFLOAD ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.27	200	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			7.34	300	
LAUNCH VEHICLE FHA/OHAUT FUEL/DEFUEL ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.84	40	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			23.13	400	
PAYLOAD PROCESSING FACILITY INCIDENT DURING SATELLITE FUELING/TESTING	CONNECTION LEAK MINOR HOSE FAILURE	N2O4 N2H4 MMH	0.06	1.0	FUEL SPILL RESPONSE OXIDIZER SPILL RESPONSE

PORTABLE PROPELLANT CONTAINER SUMMARY

- | | |
|--|------------------------------------|
| ● 55 GAL DRUMS (LEAST SAFE) | ● VAFB/VENDOR 5,000 GAL TANKERS |
| ● KSC 5/30 GAL DOT/ASME DRAIN CONTAINERS | ● KSC 500 GAL GPTU |
| ● SA-ALC 2,000 LB CYLINDERS | ● KSC/VENDOR 2,500 GAL TANKERS |
| ● PROGRAM-SPECIFIC GSE CARTS | ● 10,000 GAL RAIL CARS (MOST SAFE) |

ORDATCH2

APPENDIX D

**DRAFT OPERATIONAL REQUIREMENTS DOCUMENT
FOR A
FALSE-ALARM IMMUNE HYDRAZINE FLAME DETECTION SYSTEM (ORD)**

**OPERATIONAL REQUIREMENTS DOCUMENT (ORD) FOR A
FALSE ALARM-IMMUNE HYDRAZINE FLAME DETECTION SYSTEM**

1. General Description of Operational Capability:

a. Space vehicle launch and payload processing facilities at Cape Canaveral Air Station, Florida (CCAS) and at Vandenberg Air Force Base, California (VAFB) support all major United States Air Force (USAF) and commercial satellite space launch operations. These facilities support systems and processes that involve the storage and transfer of highly flammable, explosive and toxic hydrazine fuels.

b. Hydrazine-based fuels are found in very large bulk quantities only at CCAS and VAFB. Hydrazine is used in small quantities at bases supporting F-16 and B-2 APU systems, and Peace Keeper strategic missiles. However, unique fire detection requirements have not been identified. Anhydrous Hydrazine, AH (N_2H_4), and its derivatives, monomethylhydrazine, MMH (CH_5N_2), unsymmetrical dimethylhydrazine UDMH ($C_2H_8N_2$), and Aerozine 50 (A-50), a 50:50 percent mixture of AH and UDMH, are extremely toxic by inhalation and skin contact routes. They spontaneously and violently react when contacted with oxides, such as rust, dust and debris, flame or spark.

c. CCAS and VAFB technicians are involved in several hazardous processes where reliable and rapid detection of hydrazine fires will be essential in preventing serious injury or death, and the potential for significant facility and environmental damage. These include:

(1) Loading/unloading 2,500 - 5,000 gallon mobile tankers at bulk storage facilities.

(2) Hydrazine transfers from mobile tankers or 55-gallon drums to specialized propellant containers for payload fueling.

(3) Maintenance of mobile propellant tankers and specialized satellite fueling containers.

(4) Maintenance of fixed storage tanks, transfer, and distribution systems at central bulk storage sites and at launch complex ready storage facilities.

(5) Propellant fuel (A-50) off-load at Titan IV ready storage sites.

(6) Titan IV Stage I & II A-50 fueling from on-site ready storage tanks. Delta Stage II launch vehicle A-50 fueling operations from 2,500 gallon KSC mobile tanker trailers (CCAS) and/or a Delta fuel trailer (VAFB).

(7) Satellite fueling operations in ground-level or launch tower clean room facilities and Centaur fueling in launch tower clean rooms.

d. Fires fueled by Anhydrous Hydrazine and its derivatives are virtually smokeless and emit little or no visible radiation. Technicians involved in hypergolic propellant fuel operations wear fully-encapsulated protective ensembles. These include vision-restricting helmets and face plates. Because of the near-invisible nature of hydrazine flames and limited fields of vision, these personnel have extreme difficulties in identifying the location and size of a hydrazine fire, its rate of growth, and direction of spread. In a past hydrazine fire incident at CCAS during a propellant container maintenance operation, technician proximity to a hydrazine fire remain undetected until a very dangerous secondary effect was recognized - the melting of the individual's protective ensemble components. In such cases, these very dangerous conditions can lead to ineffective use of portable fire extinguishers, delayed or ineffective emergency actions and evacuation to include system shutdown and sounding alarms, as well as technician injury or death.

e. CCAS and VAFB facilities and processes with hydrazine fire hazards urgently need an automatic detection system that can reliably detect hydrazine and hydrazine derivative flames and warn personnel. Current technology optical fire detectors and human "eyeballs" do not have the capability to reliably discriminate hydrazine fires. Additionally, UV and/or UV/IR detectors can react to non-flame false alarm stimuli, such as sunlight, welding, and various emissions from light sources. UV and UV/IR detectors have been associated with a history of false alarms and false activations of USAF hangar and aircraft shelter fire protection systems over the past several years.

f. This ORD is in direct support of the Air Force Space Command's Mission Need Statement (MNS), AFSPC XX-YY, ----- (There may be 1 MNS for military space lift support and a different one for commercial support.) This(These) MNS is/are in direct support of OUSD (A) Mission Area (s) XXX, YYY-----.

g. This ORD also supports Air Combat Command (ACC) MNS CAF 311-90, New Generation of Fire Fighting and Crash Rescue Systems, which identifies the need for improved fire detection and fire fighting agents.

h. The Requirements Correlation Matrix (RCM) for a hydrazine flame detection system is at Attachment 1.

2. Threat:

a. Hydrazine fuel fires at CCAS and VAFB require rapid, reliable detection and the sounding of electronic, visible and audible alarms to enable immediate technician emergency actions and to minimize fire department response time to initiate fire suppression and rescue operations. A hydrazine flame detection system can significantly reduce the potential for loss of life and property following an accidental release and fire during hydrazine transfer and/or container maintenance operations. Hazard analyses were conducted to determine the mechanisms and locations of accidents or incidents on CCAS and VAFB that would involve the release of propellant fuels and, consequently, trigger a fire that could be detected by a hydrazine flame detection system. Accidental releases of hypergolic propellants on CCAS and VAFB were assumed to result from incidents involving propellant containers, mobile tanker-trailers, and/or the transfer equipment used to pump and distribute the commodities from one container to another, or into the launch vehicle and payload on-board tanks. The potential fixed facility locations where such accidents were most likely to occur were determined by mapping the receipt, storage and end-use distribution flow chart-histories of hydrazine fuels on CCAS and VAFB.

b. Six facility-related accidental hypergolic chemical release hazard scenarios resulting from common space launch system processing and support operations at CCAS and VAFB were identified. These scenarios represent a spectrum of generalized hydrazine fuel fire threats facing at CCAS and VAFB fixed facilities that could be identified by installed flame detection systems. They are:

(1) Accident during propellant storage container sampling operation at bulk storage facilities. The release mechanisms are over-filled glass sample bottles, dropped glass sample bottles, and the improper seating of sample draw equipment connections.

(2) Accident during propellant container or mobile tanker maintenance at bulk storage facilities. The propellant is released when an access port or container penetration component at or near the bottom of the container is removed with residual chemical remaining. This causes the gravity flow of the propellant on to the pavement or ground below.

(3) Mating accident involving a fueled satellite payload. Two primary release mechanisms are assumed. The first is caused by impact or shock to the payload propellant system from the accident situation. This would then cause a break or material failure (such as at a weld or pipe connection) in a tank or distribution line. The second mechanism is assumed to be a penetration of a propellant tank by another rigid object. In both cases, propellant would escape under pressure to the surrounding area. The propellant could be contained within the satellite's transportation shroud or be could be released to the open air in a clean room or outdoor accident site.

(4) Propellant transfer accident at bulk storage facilities. Three release mechanisms are assumed: (a) Improper seating or failure of connection hardware of stainless steel flexible transfer hose sections, (b) Minor material failure of stainless steel flexible hose section, such as a small tear, split or rupture. (c) Major material failure of stainless steel flexible hose during propellant transfer operation or Propellant Transfer Unit component material failure.

(5) Propellant release accident during launch vehicle fueling or defueling operations. Release mechanisms and volumes are identical to those defined in the previous sub-paragraph for bulk storage facility propellant transfer accidents.

(6) Accidental release during propellant transfer operations in payload processing facility clean rooms. Assumed release mechanisms are: (a) Improper seating or failure of connection hardware of stainless steel flexible transfer hose sections, and, (b) Material failure of stainless steel flexible hose section, such as a small tear, split or rupture.

Attachment 2 provides a summary of these hydrazine incident scenarios, the corresponding expected hydrazine release quantities and fire threat consequences.

c. "Sabotage Threat To USAF Space Launch Facilities. (A specific threat dealing with CCAS and VAFB terrorist threats & sabotage involving hypergolic propellant storage tank or transfer vehicles or the launch vehicles at the pads?).

d. "Threat Compendium, Worldwide Threat To Air Bases: 1991-2001", 31 Dec 91. Provides descriptions of the systems, weapons, and organizations representing an air- and land-based threat to USAF Bases. (Note: the terrorist threat to CCAS & VAFB may be contained in this document. If so, cite this document in both paragraph c & d).

3. Shortcomings of Existing Systems:

a. Background Data On Hydrazine Fires & Optical Flame Detector Reliability And Response Capabilities:

(1) Hydrazine burns at a rate that is about 10 times as fast as a hydrocarbon fuel fire. Therefore, it is more intense and spreads faster. Additionally, hydrazine fires are virtually colorless and smokeless. This is because the carbon-based compounds that are contained in and produced by jet or automotive fuel fires are not present in hydrazines to produce black smoke and the characteristic yellow-orange flame. Because of these spectral qualities, current UV/IR UV-alone or IR-alone optical detectors cannot reliably detect the characteristic hydrazine flame. There are no commercially-available hydrazine-specific fire or flame detectors available for purchase.

(2) USAF experience with UV/IR hydrocarbon fire detectors in aircraft hangar applications has not been satisfactory. Research has shown that there are many combinations of UV (sunlight, welding, etc.) and IR (motor vehicles, electric motors, lighting systems, etc.) energy at certain distances from UV/IR detector heads that fall within the specified hydrocarbon fire detection sensitivities and combine to produce false alarms. Numerous suppression system "false dumps" in recent years has validated this potential. Many suppression systems have been placed in the manual activation mode to prevent inadvertent agent release. Since there is very little or no UV or IR energy in those spectral ranges monitored by commercial UV/IR systems, their use for hydrazine detection is not feasible.

(3) Another technology deficiency is that there is very little published hydrazine and hydrazine derivative flame spectral data. None is sufficient to design and/or calibrate a new hydrazine technology flame detection system. A recent Wright Laboratories Air Base Fire Protection And Crash Rescue Systems Branch (WL/FIVCF) study identified 4,450 potential sources of data on hydrazine flames using a SURVIAC search. Of this number, only one report had some partially-useable data. This was from a laboratory test analysis with little or no relevance to CCAS and VAFB field conditions where hydrazine flame detection would be required. Additionally, an unpublished 1986 NASA test report provides some spectral data from very small fires at distances of only 8 and 30 centimeters. No spectral data defining fire sizes, detection ranges and other boundary conditions, such as the collateral combustion of involved materials (vegetation, vehicle & electronic components, etc.) are known to exist.

4. Capabilities Required:

The space launch organizations at CCAS and VAFB require the development and acquisition of a hydrazine and hydrazine derivative flame detection system for interior and exterior (outdoor) use at propellant transfer and storage facilities and inside payload processing clean rooms.

a. System Performance:

(1) Performance Parameters. The hydrazine flame detection system is envisioned to be a family of detection systems or a system that can be calibrated to react to flames from each of the hydrazine fuel types, and to take into account the various fire incident locations, collateral fire involvement site conditions and site-specific false alarm sources. *It is not required (but is desirable) that one single hardware configuration will be able to satisfy all of the below-listed system performance parameters.* This ORD assumes separate, but similar systems with multiple common parts, will be required for specific site conditions where hydrazine fires can take place.

(a) Clean Room Hydrazine Flame Detection. The hydrazine flame detection system will identify a 6-in high anhydrous hydrazine or MMH flame produced by a laboratory burner or equivalent at a 50-ft range under interior USAF ground-level and launch tower clean room equipment, background and lighting conditions. The field of view for detection shall be +/- 45 degrees as measured on a conical surface originating from the detector head central axis leading to the target flame. The total conical field of view shall be not less than 90 degrees in the horizontal and vertical directions. Anhydrous hydrazine and MMH are typical fuels for military and commercial satellite payloads and Centaur reaction control systems.

(b) A-50 Bulk Transfer & Storage Facility Flame Detection. The hydrazine flame detection system will identify a 1 square foot Aerozine-50 (A-50) pan fire at a 100-ft range under outside/exterior CCAS and VAFB fuel storage and transfer facility weather, background and lighting conditions. The field of view for detection shall be +/- 45 degrees as measured on a conical surface originating from the detector head central axis leading to the target flame. The total conical field of view shall be not less than 90 degrees in the horizontal and vertical directions. Large quantities of A-50 are stored in bulk and transported in mobile trailers to fuel Titan and Delta launch vehicles.

(c) Hypergolic Fuel Container Maintenance Facility/Site Flame Detection. The hydrazine flame detection system will identify a 1 square foot Aerozine-50 (A-50), MMH, UDMH or anhydrous hydrazine pan fire at a 100-ft range under outside/exterior CCAS and VAFB fuel container maintenance facility weather, background and lighting conditions. The field of view for detection shall be +/- 45 degrees as measured on a conical surface originating from the detector head central axis leading to the target flame. The total conical field of view shall be not less than 90 degrees in the horizontal and vertical directions.

(d) Hydrazine flame detection system response times for both 6-in flames at 50-ft and 1-square foot pan fires at 100-feet shall be 1.0 second or less for a flame/pan fire location anywhere within the 90-degree specified field of view.

(e) Hydrazine flame detection systems shall not react/alarm to visible or radiant energy sources, such as welders, lighting systems and light bulbs, weather phenomena, motors, hot exhaust systems, cigarette lighters, flashlights or other "hot" bodies, or to any combinations of intensity and distance of such spectral emissions.

(f) Hydrazine flame detection systems shall not react/alarm to any electromagnetic energy sources associated with space launch system communications or surveillance equipment, or from any transient energy that may be associated with CCAS or VAFB space launch support operations.

(g) System detection of hydrazine flames shall result in the initiation of area visible and audible alarms/klaxons and the transmission of an alarm status message to both the CCAS/VAFB fire department and one or more TBD launch squadron command and control centers. Alarm hardware and message transmission electronics shall be detection system component subsystems. Alarm messages shall be transmitted by TBD (RF and/or hard wire) data links.

(2) SEEK EAGLE Requirements. Not Applicable.

b. Logistics and Readiness:

(1) Operational Availability.

(a) Clean Room Systems. Hydrazine flame detection systems in clean rooms shall demonstrate a system availability of 99 percent over a mission time of two years.

(b) Exterior/Outdoor Systems. Hydrazine flame detection systems protecting outdoors or other non-fully enclosed processes and/or equipment shall demonstrate a system availability of 97 percent over a mission time of two years.

(c) These levels of availability are attainable with appropriate system design considerations of circuit modularity, BIT, and maintenance engineering.

(2) Expected Maintenance and Manpower Skill Levels. Hydrazine flame detection systems shall require no increase in Civil Engineering Electronics Control (AFSC XXXXX) or facility support contractor personnel equivalent manpower. The system shall be maintainable by 3- and 5-skill level technicians. Manufactures contract maintenance and CCAS/VAFB launch support contractor maintenance options shall be considered during system life cycle cost analysis and acquisition approach planning.

(3) Logistics Supportability And Readiness Requirements.

(a) Hydrazine flame detection systems will be logistically-supportable by CCAS and VAFB base supply organizations and systems. Contract maintenance is TBD.

(b) Hydrazine flame detection systems shall be operable and maintainable under the CCAS and VAFB design climactic conditions of temperature, humidity, rain, and sea salt spray for exterior electronic systems.

(c) The hydrazine flame detection system Mean Time To Repair (MTTR) to reinstate it to full operational status after a fault warning shall not exceed 4 hours.

(d) Hydrazine flame detection systems shall allow 100% fault detection and/or isolation, remove/replace and checkout using self-test or manual procedures with standard Base Civil Engineer (BCE) and/or launch support facility contractor tools and/or common support equipment.

(e) Hydrazine flame detection systems shall be designed with self-diagnostic checks on all electronic system components. Systems shall initiate a trouble/fault alarm via RF or hard wire link to the CCAS/VAFB fire departments and to a launch control command center TBD, whenever the any component is not functioning according to design specifications. Furthermore, the systems shall contain visual and audible alarm components that activate in the "trouble" mode to alert personnel that automatic flame detection may not be functioning. The frequency of

automatic internal checks and status reports to command centers and fire departments shall be 15 minutes.

c. Critical System Characteristics

(1) Mandatory Characteristics.

(a) Expected Mission Capability. Hydrazine flame detection systems will be installed in clean rooms and other launch support facilities that support hypergolic fuel transfer and storage operations. Multiple detectors will be installed to insure all hazard areas are contained within the system's hydrazine flame detection performance boundaries, as specified in Paragraph 4a(1). System detection of hydrazine flames shall result in the initiation of area visible and audible alarms/klaxons and the transmission of an alarm status message to both the CCAS/VAFB fire department and one or more TBD launch squadron command and control centers.

(b) Electronic Counter-Countermeasures (ECCM) and Wartime Reserve Modes (WARM) Requirements. Not Applicable.

(c) Conventional, Initial Nuclear Weapons Effects, Nuclear, Biological, and Chemical Survivability. Not Applicable.

(d) Environmental Factors. Hydrazine flame detection systems must be capable of reliable, continuous operation under the climactic conditions associated with CCAS and VAFB weather statistics.

1 Systems must be able to operate in temperatures ranging from -10 °F to +140 °F.

2 Systems must incorporate appropriate environmental storage control systems and fabrication materials to prevent system damage from cold, heat, humidity or thermal expansion.

3 Materials used in the fabrication of systems will not support the growth of fungi to the best commercial practices.

4 System performance capabilities will not be adversely affected by wind-blown dust, sand or sea salt spray. Cleaning maintenance schedules for exposed detector heads/optics shall be developed to account for these expected outside use conditions.

5 System components will withstand the UV effects of sunlight with minimal material degradation for the system service life.

6 Environmental requirements for weather seals, air tightness, humidity, marine atmosphere, low temperature, temperature shock, heat transfer, blowing sand, dust, UV effects, solar loads and water tightness shall be IAW MIL-STD-810E.

(e) Electromagnetic Compatibility and Frequency Spectrum Assignment.

1 Hydrazine flame detection systems shall not adversely react to electromagnetic energy emissions associated with space launch ground support, payload processing or on-board satellite communications/telemetry systems.

2 New RF communications frequencies are not required. Systems shall use the currently-assigned RF operating frequencies of the fire department alarm systems and of the launch/processing control centers for each launch system at CCAS and VAFB.

(f) Safety Parameters.

1. Electromagnetic energy emissions from hydrazine flame detection systems shall not present a hazard to space systems, aircraft or air crews operating from or near CCAS or VAFB.

2. The use and maintenance of the hydrazine fire detection systems shall be prescribed in documented procedures for hazardous dynamic transfer and system configuration operations and the surveillance of unattended hypergolic fuel storage and transfer systems. Procedures shall be based on the results of MIL-STD-882C system safety hazard analyses for each potential system application/location.

(2) Security. Owner/user security applies IAW AFI 31-209. Security is provided by the facility/property protection standards associated with each location where hydrazine flame detection systems are installed and the security classification of the launch vehicle and payload systems. Additional security considerations are not required.

(3) Electronic Counter-Countermeasures. Not applicable.

(4) Software Engineering. TBD.

5. Integrated Logistics Support:

An ILSP is not required. Existing logistics support for commercial optical fire detection systems shall be applied. No additional logistics support is required.

a. Maintenance Planning. All components of hydrazine flame detection systems must be easily assembled, installed and maintained. Existing tools, test measurement and diagnostic equipment (TMDE), and/or presently approved, emerging TMDE or support equipment will be used. Specialized TMDE or tools, if required, will be supplied with the system equipment.

(1) Maintenance and repair will be accomplished at the facility support O&M organizational level or by manufacturer contract maintenance. Periodic inspections and preventive maintenance tasks will be programmed to ensure operational status.

(2) The level of replacement shall be at the major component level, defined to be detectors, logic/electronic controller, strobe/siren alarm system, RF transmitter(s), and cables/connection devices.

(3) The level of repair shall include only the detectors, logic/electronic controller and RF transmitter(s). All other items shall be repaired by replacement.

(4) Maintenance Requirements For On- and Off-Equipment Maintenance. TBD.

(5) Time-Phased Depot Requirements. Not Applicable.

(6) Organic Support Capabilities. TBD

(7) Depot Tasks and Capabilities Required. None.

b. Support Equipment.

(1) Standard Support Equipment. Hydrazine flame detection systems will be self-contained and require no additional support equipment.

(2) Depot level Support Equipment. Not applicable.

(3) Test and Fault Isolation Capabilities.

(a) Hydrazine flame detection systems shall maximize the use of built-in test equipment to negate the need for redundant SE, isolate the faulty system modules, and determine system availability for use.

(b) System level fault isolation will identify the major component at 100 percent for organizational replacement and/or repair.

(c) Systems must notify the supporting fire department and operational control center (s) of a malfunction with an audible and visible status signal.

c. Human Systems Integration (HSI):

(1) Operational And Maintenance Training Concept. Initial training for the operation and maintenance of hydrazine flame detection systems shall be by system technical data and on-site manufacturer training/technical support. No additional training support is required.

(2) Manpower, Personnel And Training Constraints. No additional manpower is required for training, maintenance or employment of the hydrazine flame detection system. Additional manpower to support system O&M is not required.

(3) Human Performance/Human-In-Loop Issues.

(a) Using Command.

1. Manpower, Personnel, Training, Safety, Human Factors Engineering, and Health Hazards Constraints. None.

2. Maintenance and Training Concepts. Described in Paragraph 5c.

(b) Supporting Command. No depot manpower or training requirements are identified.

(4) Participating Command manpower Requirements. Not applicable.

(5) Training and Training Support.

(a) Operational training Tasks. To be determined by manufacturer technical data.

(b) Maintenance Training Tasks. To be determined by manufacturer technical data.

(c) Training Support For Required Operational Capabilities and Maintenance Requirements. To be determined by manufacturer technical data.

(d) Airspace and Range Training Requirements. Not applicable.

d. Computer Resources. Not Applicable.

e. Other Logistics Considerations.

(1) Supply Support.

(a) Hydrazine flame detection system components shall not require special storage or storage equipment.

(b) Repair/replacement items for hydrazine flame detection system components shall be added to the CCAS and VAFB facility O&M organizational/contract bench stock systems, in accordance with the initial purchase contract specifications with the manufacturer. CCAS and VAFB maintenance organizations will be provisioned through standard USAF or contractor logistics channels. No special supply support will be required.

(c) Equipment and component spares will be identified in a repair-level analysis, and will be purchased and stocked as a part of the initial purchase contract IAW AFI 10-602.

(d) Packaging, Handling and Transportation (PH&T).

1. PH&T requirements must be developed and implemented IAW the AFI 24-series directives. Requirements will be consistent with the program schedule and will be interfaced with other ILS elements.

2. Hydrazine flame detection system and/or components will be designed and packaged to withstand expected shocks of transportation and handling IAW MIL-STD-810E.

3. Systems and system components shall be packaged so they will not be adversely affected by prolonged storage under any climactic conditions.

(e) Preservation, Packing and Packaging for system components shall be designed to commercial fire detector industry standards and shall provide the degree of protection and handling provisions necessary based on the characteristics of the item and its source, destination, storage and mode of transportation. System components shall

use preservation, packaging and packing methods and materials currently in use by the commercial fire detector industry.

(f) Provisioning Strategy. Hydrazine flame detection systems shall be supplied/stocked through normal USAF and/or facility O&M support contractor supply channels and procedures.

(2) Technical Data.

(a) Technical manuals for operating and maintaining Hydrazine flame detection systems and system components will be provided by the manufacturer. These manuals and other related technical data will be fully validated by the Air Force during a demonstration by the manufacturer of an initial prototype system installation at CCAS or VAFB.

(b) Technical manuals shall include an appropriate technical and functional description of the system and its components. Data shall include system installation, operation and maintenance, refurbishment of detectors, RF transmitters and logic controllers. Logic controller software and detector calibration/sensitivity data also shall be fully documented.

(c) Production drawings and electrical schematics shall be provided.

(3) Facilities And Land.

(a) Hydrazine fire detection systems will be installed in/on existing CCAS and VAFB hydrazine fuel storage areas, transfer location and clean room facilities.

(b) Hydrazine fire detection system spare components will be stored in existing CCAS and VAFB supply warehouses and fire department bench stock areas.

(4) Logistics Support Analysis (LSA). Preparation of a LSA is not anticipated.

(5) Hazardous Materials. Hydrazine fire detection system design and construction will minimize the use of hazardous materials in production. Magnesium and magnesium alloys shall not be used.

(6) Computer-Aided Acquisition Logistics Support (CALS). Requirements are TBD.

(7) Supporting Command Requirements.

(a) Additional Depot Facilities. None required.

(b) Special Handling, Storage and Transportation Requirements. None required.

(c) Engineering Data and Rights. Proprietary hardware ownership is anticipated and may be retained by the manufacturer. However, ownership of the source plans should revert to the Government in the event the owner discontinues the product line or ceases to exist. The Government should have the right to purchase the hardware source plans.

(d) Depot and System Technical Order Requirements. None required.

(e) Disposal of Hazardous Waste. Not applicable. Hydrazine fire detection system components should not contain or produce hazardous waste.

(f) Special Force Management Concepts. Not applicable.

(g) Plans For Advanced technology. Not Applicable.

(h) Configuration Control Concepts. TBD.

(i) Spares Strategies. System component spares will be provided and stored at the base/O&M support contractor level.

(j) Sustaining engineering. Engineering support shall be provided by the manufacturer for the life of the system.

(k) System Warranties and Guaranties. The hydrazine fire detection system shall include a manufacturer's warranty that is easily administered and is consistent with the system maintenance concept. It must be cost-beneficial and include the selected essential performance requirements. The use of this warranty must be transparent to the user's operation and maintenance of the system. The development and approval of the warranty plan must be accomplished not later than 6 months after the award of the contract for engineering and manufacturing development.

1 Warranty Administration. The body of the warranty must describe, in detail, the specific requirements to administer the warranty. The administration section of the warranty plan will identify the administrative requirements. This section also must identify and assign responsibilities for processing warranty claims, for item disposition from CCAS/VAFB to the manufacturer's repair facility, and the return of the warranted item to the supply system. The administration plan also must describe the exact method of determining failures, including the manual or automated system used to accomplish warranty tracking efforts. It is essential that the selected operational performance requirements defined in the contract specifications be measurable by standard USAF data collecting systems to prevent the warranty from being unmeasurable and, consequently, unenforceable.

2 Warranty Policy. DOD policy is to obtain only warranties that are cost-effective. Cost-benefit analysis methodologies must be used and a summary of the results provided to AFSPC/CE to determine if the proposed warranty is cost-effective and to provide the documentation necessary to process a waiver, should the warranty not be cost-effective.

(1) Environmental Stress Screening. TBD.

(m) Postfielding Data Collection Efforts.
TBD.

(8) Information Needs. No special or additional directives or forms are required to support the addition of this detection system to the USAF supply inventory.

6. Infrastructure Support And Interoperability:

a. Command, Control, Communications And Intelligence. Hydrazine fire detection systems shall include an alerting capability to notify the supporting fire department and launch/payload operational control center (s) of system activation or malfunction.

b. Transportation And Basing. Hydrazine fire detection systems and components shall be land and air transportable via the commercial package express industry.

c. Standardization, Interoperability, And Commonality.

(1) Hydrazine flame detection systems will be compatible with standard 120 VAC/60 Hz electrical power sources available or others to be specified at the CCAS and VAFB facilities where use is planned.

(2) Joint Potential Designation. TBD.

The system will be commercially available for purchase by any DOD, other federal and municipal fire service organization or commercial business with a hydrazine fire hazard detection requirement.

d. Mapping, Charting And Geodesy Support. Not Applicable.

e. Environmental Support. Not Applicable.

7. Force Structure:

A single hydrazine fire detection system can consist of one or more logic controllers, from 2 to 20 detector heads, one RF transmission system and one or more visual/audible alarm subsystems. Exact design configurations at CCAS and VAFB are TBD. A Preliminary estimate of minimum Air Force requirements is:

a. CCAS.

(1) Fuel Storage Area #1.

(a) Mobile Tanker Hydrazine Storage Area

(b) Hypergolic Stockpile Storage Facility (HSSF) transfer apron area.

(c) Hydrazine Drum Storage Area

(d) Portable container/mobile trailer maintenance hardstands.

(2) All ground-level and MST/launch tower payload processing facility clean rooms, including off-base contractor-operated facilities.

(3) SLC 40/41 Titan IV Fuel Handling Areas

(4) SLC 17 A/B Delta Stage II A-50 fueling vehicle/support equipment areas.

b. VAFB.

(1) Hypergolic Stockpile Storage Facility (HSSF).

(a) Mobile Tanker Hydrazine Load/Offload Area

(b) Fuel storage tank clusters/containment areas.

(c) Hydrazine Drum Storage Area

(d) Portable container/mobile trailer maintenance hardstands.

(2) All ground-level and MST/launch tower payload processing facility clean rooms, including on-and off-base contractor-operated facilities.

(3) SLC 4E/W Titan IV Fuel Handling Areas

(4) SLC 2 E/W Delta Stage II A-50 fueling vehicle/support equipment areas.

8. Schedule Considerations:

a. IOC/FOC will be attained upon delivery of the required initial inventory of hydrazine flame detection systems are installed and performance validated at the CCAS and VAFB facilities/locations defined in Paragraph 7.

b. Required IOC Date: FY 97.

2 Atch

1. Requirements Correlation Matrix
2. Hazard Scenario Summary

REQUIREMENTS CORRELATION MATRIX

PART I

As Of Date:

SYSTEM CAPABILITIES AND CHARACTERISTICS	ORD I		ORD II		ORD III	
	Thresholds	Objectives	Thresholds	Objectives	Thresholds	Objectives
1. Agent Application Time To Extinguish 100 SF Hypergolic Fuel Fire *	15 Seconds	< 15 Seconds				
2. Agent Application Time To Extinguish 100 SF Hypergolic Oxidizer-Enriched Hydrocarbon Fuel Fire	15 Seconds	< 15 Seconds				
3. Minimum Foam Agent Burnback Time	5 Minutes	> 5 Minutes				
4. Minimum Foam Agent Vapor-Seal Performance						
a. Hydrazines *	1 PPM	< 1 PPM				
b. Nitrogen Tetroxide *	10 PPM	< 10 PPM				
5. Minimum Foam Agent Expansion Ratio	200 X	> 200 X				
6. Minimum Foam Agent 25% Drainage Time *	4 Minutes	> 4 Minutes				
7. Minimum Foam Agent 50% Collapse Time *	30 Minutes	> 30 Minutes				
8. Foam Agent Storage & Delivery System						
a. Towable *	3/4 Ton P/U	1/2 Ton P/U				
b. Agent Storage Capacity *	500 Gallons	> 500 Gallons				
9. Operational Temperature Range						
a. Water-Based Agents/Foams *	+34 - 140 °F	+34 - 140 °F				
b. Dry Chemical Agents/Additives *	TBD - 140 °F	TBD - 140 °F				

Note 1: An * Denotes An Item To Be Placed In The APB As A Key Parameter

AGENTRCM

REQUIREMENTS CORRELATION MATRIX						
PART I				As Of Date:		
SYSTEM CAPABILITIES AND CHARACTERISTICS	ORD I		ORD II		ORD III	
	Thresholds	Objectives	Thresholds	Objectives	Thresholds	Objectives
10. Non-Toxic Agent/Foam/Additive Constituent Chemicals *	Non-Toxic	Non-Toxic				
11. Agent/Foam/Additive Storage Shelf Life *	5 Years	10 Years				
12. Agent/Foam/Additive Bulk Storage Container Requirements						
a. Capacity: Liquid Agents*	10 Gallons	10 Gallons				
b. Capacity: Dry Chemical Agents*	50 Pounds	50 Pounds				
c. Rapid, Field Refill Hardware - Liquid Agents Only *	Integral Pouring Spout & Air Vent	Integral Pouring Spout & Air Vent				

Note 1: An * Denotes An Item To Be Placed In The APB As A Key Parameter 2

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REQUIREMENTS CORRELATION MATRIX
Part II

(Supporting Rationale for System Characteristics and Capabilities)

AS OF DATE:

Parameter 1 - Clean Room Flame Detection Sensitivity. These threshold parameters define the size of the hydrazine and MMH flame column and the maximum range at which it must be detected for acceptable flame detection system performance in clean room applications.

Parameter 2 - Outdoor A-50 Bulk Storage & Transfer Facility Flame Detection Sensitivity. These threshold parameters define the size of the A-50 pan fire and the maximum range at which it must be detected for acceptable flame detection system performance in outdoor facility applications. Outdoor systems will require significantly more tolerance to false alarm stimuli than for clean room applications, to include sunlight, welding, weather effects, vehicles and lighting systems.

Parameter 3 - Hypergolic Fuel Container Maintenance Facility Flame Detection Sensitivity. These threshold parameters define the size of the A-50, UDMH, hydrazine and MMH fires and the maximum range at which they must be detected for acceptable flame detection system performance in all outdoor facility applications involving container maintenance and transfer from container to container. Outdoor systems will require significantly more tolerance to false alarm stimuli than for clean room applications, to include sunlight, welding, weather effects, vehicles and lighting systems.

Parameter 4 - Detector Field Of View. This criterion defines the acceptable conical area of performance within which a single hydrazine flame detector head must successfully recognize a 1-SF hydrazine (or derivative) pan fire at a 100-FT distance.

Parameter 5 - Detector System Response Time. This parameter defines the maximum permissible time period between the ignition of a 1-SF pan fire and the initiation of a fire alarm message to the defined control centers by the system logic controller and RF transmitter. Within this time period the hydrazine flame detection system must recognize and confirm the presence of an actual flame threat, and not a false alarm source.

Parameter 6 - False Alarm Immunity. This criterion defines the possible false alarm stimuli to which the hydrazine flame detection system must not react. Detectors must be immune to both single and multiple false alarm sources, and in varying distances from the detector head (s) and energy emission intensities. A more definitive list of false alarm stimuli and validation test protocols that must be passed will be provided by the WL/FIVCF Air Base Fire Protection and Crash Rescue Systems Branch.

CCAS/VAFB HYPERGOLIC PROPELLANT HAZARD SCENARIO SUMMARY

RELEASE SITUATION	RELEASE MECHANISM	MATERIAL RELEASED	CREDIBLE RELEASE (GAL)		FIRE DEPARTMENT CONSEQUENCES
			MINOR	MAJOR	
PROPELLANT SAMPLING ACCIDENT	OVERFILLED/DROPPED SAMPLE FLASK HOSE/CONNECTION LEAK	N2O4 N2H4 A-50 MMH	0.03	0.25	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
PROPELLANT CONTAINER/ TANKER MAINTENANCE ACCIDENT	UNDETECTED RESIDUAL RELEASED DURING TEAR-DOWN	N2O4 N2H4 A-50 MMH	0.25	0.25	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
TRANSPORTATION OR PAY- LOAD MATING ACCIDENT W/ FUELED SATELLITE	SHOCK-INDUCED LEAK FUEL TANK PENETRATION	N2O4 N2H4 MMH	7.5	12.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
BULK HYPERGOL STORAGE TANK LOAD OR OFFLOAD ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.27	200	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			7.34	300	
LAUNCH VEHICLE FHA/OHA/UT FUEL/DEFUEL ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.84	40	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			23.13	400	
PAYLOAD PROCESSING FACILITY INCIDENT DURING SATELLITE FUELING/TESTING	CONNECTION LEAK MINOR HOSE FAILURE	N2O4 N2H4 MMH	0.06	1.0	FUEL SPILL RESPONSE OXIDIZER SPILL RESPONSE

PORTABLE PROPELLANT CONTAINER SUMMARY

- | | |
|--|------------------------------------|
| ● 55 GAL DRUMS (LEAST SAFE) | ● VAFB/VENDOR 5,000 GAL TANKERS |
| ● KSC 5/30 GAL DOT/ASME DRAIN CONTAINERS | ● KSC 500 GAL GPTU |
| ● SA-ALC 2,000 LB CYLINDERS | ● KSC/VENDOR 2,500 GAL TANKERS |
| ● PROGRAM-SPECIFIC GSE CARTS | ● 10,000 GAL RAIL CARS (MOST SAFE) |

ORDATH2A

APPENDIX E

DRAFT OPERATIONAL REQUIREMENTS DOCUMENT (ORD)
FOR AN
OPTIMUM HYPERGOLIC PROPELLANT FIRE FIGHTING AGENT

**OPERATIONAL REQUIREMENTS DOCUMENT (ORD) FOR AN
OPTIMUM HYPERGOLIC PROPELLANT FIRE FIGHTING AGENT**

1. General Description of Operational Capability:

a. The fire departments at Cape Canaveral Air Station, Florida (CCAS) and at Vandenberg Air Force Base, California (VAFB) are the only two units in the USAF that must be equipped and trained to respond to accidental releases and fires involving very large quantities of highly toxic hypergolic fuels, hydrazine and its derivatives, and nitrogen tetroxide, a hypergolic oxidizer. Their mission is to provide structural, crash, rescue, and fire prevention capabilities for the launch support facilities, space launch vehicles, payloads, and hazardous propellant storage and transfer facilities involved in United States Air Force (USAF) and commercial satellite launch operations. Hydrazine-based fuels are used in small quantities at bases supporting F-16 and B-2 APU systems, and Peace Keeper strategic missiles. However, special fire fighting agent requirements have not been identified.

b. CCAS and VAFB fire department emergency response operations to hydrazine fuel or nitrogen tetroxide oxidizer release incidents or accidents can involve exposure to the combined flame and highly toxic liquids and vapor effects of these hypergolic propellants.

(1) Anhydrous Hydrazine, AH (N_2H_4), and its derivatives, monomethylhydrazine, MMH (CH_6N_2), unsymmetrical dimethylhydrazine UDMH ($\text{C}_2\text{H}_8\text{N}_2$), and Aerozine 50 (A-50), a 50:50 percent mixture of AH and UDMH, are extremely toxic by inhalation and skin contact routes. Hydrazine burns at a rate that is about 10 times as fast as a hydrocarbon fuel fire. Therefore, it is more intense and spreads faster. Hydrazines spontaneously and violently react when contacted with oxides, such as rust, dust and debris, flame or spark.

(2) Nitrogen Tetroxide (N_2O_4) is not flammable. However, when added to a fire, it enriches the fire intensity of combustion and burning rate by providing an additional oxygen source. Nitrogen tetroxide and its vapors explode on contact with hydrazine fuels, amines and furfuryl alcohol. Additionally, it can cause ignition on contact with wood, paper and hydrocarbon fuels. Oxidizer-enriched fires will produce more heat and be more difficult to extinguish. Intense white flames can be produced. The smoke signature produced is that normally associated with NFPA Class A (wood & paper products) and B fires (hydrocarbon fuels). This chemical is extremely toxic, and presents a serious health

risk through skin and eye contact, and inhalation routes. It reacts with skin moisture and with water in the lungs to produce nitric and nitrous acids that destroy contacted tissues.

c. CCAS and VAFB fire fighters urgently need an effective fire fighting agent to combat hydrazine and N_2O_4 -enriched fires. Current fire fighting agents are water, aqueous film-forming foam (AFFF) and dry chemical (potassium or sodium bicarbonate). Because of the toxicity and explosive nature of these chemicals, effective fire fighting agents and fire department tactics to deal with the range of threats associated with CCAS and VAFB space launch operations are essential. This capability is an immediate requirement, since CCAS launch operations are projected to continue to increase over the next several years. These operations will result in increases of the frequency of hypergolic propellant transportation, transfer and use in launch vehicles and payloads. In turn, these hazardous operations will increase the overall probability of an accidental release with the potential for a fire situation to result.

d. This ORD is in direct support of the Air Force Space Command's Mission Need Statement (MNS), AFSPC XX-YY, ----- (There may be 1 MNS for military space lift support and a different one for commercial support.) This(These) MNS is/are in direct support of OUSD (A) Mission Area (s) XXX, YYY-----.

e. This ORD also supports Air Combat Command (ACC) MNS CAF 311-90, New Generation of Fire Fighting and Crash Rescue Systems, which identifies the need for improved fire detection and fire fighting agents.

f. The Requirements Correlation Matrix (RCM) for a optimum hypergolic propellant fire fighting agent is at Attachment 1.

2. Threat:

a. The primary causes of hypergolic chemical release and potential fires at CCAS and VAFB that would require fire fighter suppression and rescue response are accidents during lift vehicle and payload processing operations. These normally occur during the transfer of propellant chemicals from bulk or mobile storage containers into a launch vehicle or payload on-board fuel tank. Hazard analyses were conducted to determine the mechanisms and locations of accidents or incidents on CCAS and VAFB that would involve the release of hypergolic propellants and, consequently, trigger a fire department emergency response. Accidental releases of hypergolic propellants on CCAS and VAFB were assumed to result from incidents involving propellant

containers, mobile tanker-trailers, and/or the transfer equipment used to pump and distribute the commodities from one container to another, or into the launch vehicle and payload on-board tanks. The potential locations where such accidents were most likely to occur were determined by mapping the receipt, storage and end-use distribution flow chart-histories of hydrazine fuels and nitrogen tetroxide on CCAS and VAFB.

b. Nine accidental hypergolic chemical release hazard scenarios resulting from common space launch system processing and support operations at CCAS and VAFB were identified. These scenarios represent a spectrum of generalized hypergolic chemical/fire threats facing the CCAS and VAFB fire departments. Each can generate a fire department requirement to provide fire suppression, rescue and/or HAZMAT emergency response, or a combined fire-HAZMAT operation. They are:

(1) Accident during propellant storage container sampling operation. The release mechanisms are over-filled glass sample bottles, dropped glass sample bottles, and the improper seating of sample draw equipment connections.

(2) Accident during propellant container or mobile tanker maintenance. The propellant is released when an access port or container penetration component at or near the bottom of the container is removed with residual chemical remaining. This causes the gravity flow of the propellant on to the pavement or ground below.

(3) Roadway vehicle accident involving propellant containers or tanker-trailers. The release mechanism is assumed to be a puncture or break in the portable hypergolic propellant container or tank that results from damage sustained in a transportation vehicle accident.

(4) Loading or unloading accident involving a dropped propellant container. A puncture or break in a portable hypergolic propellant container is assumed to result from damage sustained in a container loading/off-loading accident.

(5). Vehicle accident involving propellant sample containers. Assumed release mechanisms are broken glass sample bottles and/or damaged Hoke bottles. Exterior carrier containers are assumed to have broken open. The propellants are assumed to be released at the accident site.

(6) Transportation or mating accident involving a fueled satellite payload. Two primary release mechanisms are assumed. The first is caused by impact or shock to the payload propellant system from the accident situation.

This would then cause a break or material failure (such as at a weld or pipe connection) in a tank or distribution line. The second mechanism is assumed to be a penetration of a propellant tank by another rigid object. In both cases, propellant would escape under pressure to the surrounding area. The propellant could be contained within the satellite's transportation shroud or be could be released to the open air in a clean room or outdoor accident site.

(7) Propellant transfer accident at bulk storage facilities. Three release mechanisms are assumed: (a) Improper seating or failure of connection hardware of stainless steel flexible transfer hose sections, (b) Minor material failure of stainless steel flexible hose section, such as a small tear, split or rupture. (c) Major material failure of stainless steel flexible hose during propellant transfer operation or Propellant Transfer Unit component material failure.

(8) Propellant release accident during launch vehicle fueling or defueling operations. Release mechanisms and volumes are identical to those defined in the previous sub-paragraph for bulk storage facility propellant transfer accidents.

(9) Accidental release during propellant transfer operations in payload processing facility clean rooms. Assumed release mechanisms are: (a) Improper seating or failure of connection hardware of stainless steel flexible transfer hose sections, and, (b) Material failure of stainless steel flexible hose section, such as a small tear, split or rupture.

Attachment 2 provides a summary of these propellant incident scenarios, the corresponding expected release quantities and fire threat consequences.

c. "Sabotage Threat To USAF Space Launch Facilities. (A specific threat dealing with CCAS and VAFB terrorist threats & sabotage involving hypergolic propellant storage tank or transfer vehicles or the launch vehicles at the pads?).

d. "Threat Compendium, Worldwide Threat To Air Bases: 1991-2001", 31 Dec 91. Provides descriptions of the systems, weapons, and organizations representing an air- and land-based threat to USAF Bases. (Note: the terrorist threat to CCAS & VAFB may be contained in this document. If so, cite this document in both paragraph c & d).

3. Shortcomings of Existing Systems:

a. Background Data On Hydrazine and Oxidizer-Enriched Fires:

(1) There are very sparse data on fire extinguishing agents and fire suppression techniques for hydrazine-family fires. This is because of the toxic and explosive threats of handling the materials, and the environmental restrictions governing their release to air, water and/or ground. Most references date back to the 1960's and were prepared to support the early Titan ICBM program. The following paragraphs summarize relevant information for study and application by the optimum hypergolic propellant fire fighting agent.

(2) Hydrazine

(a) Water Extinguishment. Water and water sprays cool hydrazine fires and dilute the fuel to a level that will not support combustion. A dilution rate of 10 parts water to 1 part hydrazine is a generally accepted rule of thumb for extinguishing an established fire. Additionally, hot metal surface re-ignition should be expected, since hydrazines have auto-ignition temperatures in the 382 - 482 °F range.

(b) Water application by crash vehicle turret or hand-held hose lines may disperse the hydrazine and "blow" it outside its original boundaries to produce a larger fire surface area. Spills on outside pavement and soil surfaces will flow with the prevailing grade and become discontinuous from depressions, curbs, drainage sumps or other surface irregularities.

(c) The application of water to produce a uniform 10:1 dilution for the entire spill surface may be difficult to achieve. NFPA-recommended application rates (1960 - 1961 Code) are from 0.20 to 0.75 GPM/square foot. Available live fire test data indicate that rates at the higher end of this range will be required for effective extinguishment, particularly if hot metal re-ignition occurs.

(3) Hydrazine Dry Chemical Agent Extinguishment

Sodium bicarbonate dry powder agents are reported to be effective against hydrazine fires. However, a CCAS fire department P-20 crew attempted to extinguish a 64 square foot pool fire in March 1994 at the Kennedy Space Center hypergol training fire pit. A full 500-pound tank application of Purple K agent (Potassium Bicarbonate) appeared to have no effect on the fire. The presence of a hot steel rim surrounding the fire pit fuel mixing sump may

have affected extinguishment performance by providing a source of continuous re-ignition. NFPA-recommended application rates (1960 - 1961 Code) are from 0.065 to 0.1 pounds per square foot.

(4) Hydrazine Foam Extinguishment and Vapor Suppression (AFFF, AFFF-P, Alcohol & Protein Foams)

(a) Limited tests of six percent AFFF were conducted by the Air Force Fire Protection Laboratory on 50 square foot MMH fires. The application rate was 0.12 GPM per square foot, and extinguishment times were 75 and 171 seconds for the two tests conducted. These extinguishment times indicate an ineffective sealing of the fire surface and the requirement for large quantities of the foam-water mixture to finally attain extinguishment. The AFFF was reported to break down following extinguishment. Burn-back resistance was not published, but can be estimated as very low.

(b) Although limited in data, these test results indicate that the 3 percent AFFF currently carried on P-4 and P-19 crash vehicles at CCAS and VAFB may be somewhat effective for initial knock down of hydrazine fires. The water in the AFFF stream will dilute a ponded spill and the surfactant should provide initial reductions in the fire surface area. The use of AFFF for vapor suppression for non-ignited or extinguished spills, probably, will not prove to be effective, since AFFF breaks down quickly. An additional foam or other agent will be required to secure the spill area against burn-back or reignition and to provide a vapor suppression blanket to minimize toxic atmospheric emissions.

(c) Alcohol, protein and combination foams (AFFF-P) produce a more durable foam structure and are reported to be acceptable extinguishing agents. They also should provide longer-term vapor suppression action, because of their increased stability. NFPA-recommended application rates (1960 - 1961 Code) for alcohol foam are from 0.1 to 0.27 GPM/square foot.

(5) Extinguishment of Oxidizer-Enriched Hydrocarbon Fuel Fires

Air Force Fire Protection Laboratory tests of 30 gallons of nitrogen tetroxide mixed with 30 gallons of diesel fuel produced a high-intensity fire with white, rather than the normal yellow-orange flames. The extinguishment mechanism reported was the application of water in a 10:1 ratio to dilute the nitrogen tetroxide to the extent it no longer supported the combusting diesel fuel. The remaining air-supported diesel fuel fire was then extinguished with AFFF. However, 75 percent of the diesel

fuel had burned before final extinguishment was attained. This indicates an extremely inefficient extinguishment mechanism, even though the addition of water was easily applied into a fixed metal burn pan test apparatus.

(6) Fire Extinguishment Using Air Force Fire Protection Laboratory-Tested Acrylic-Modified Foams

(a) Extensive vapor suppression and fire extinguishment tests of hydrazines and N2O4 were conducted by the Air Force Fire Protection Research Laboratory in the 1985 - 1986 time frame at the Nevada Test Site. The most effective foam formulation for hydrazine fires consisted of a volumetric proportioning of 10 percent Rohm and Haas Polycrylic ASE-95 Fuel Foam, 10 percent Mine Safety Appliance Research (MSAR) Corporation surfactant, and 80 percent water. Best results were obtained when the foam was applied in a 5 to 10:1 low expansion mode.

(b) The most effective foam formulation for N2O4-enriched fires consisted of a volumetric proportioning of 10 percent Rohm and Haas Polycrylic ASE-60 Oxidizer Foam, 10 percent Mine Safety Appliance Research (MSAR) Corporation surfactant containing a small amount of pectin, and 80 percent water. Best results were obtained when the foam was applied in a 150 to 300:1 high expansion mode.

b. Background Data On Existing CCAS And VAFB Fire Department Extinguishment Capabilities:

(1) The CCAS and VAFB fire departments are equipped to fight hydrazine fires with crash vehicles and pumpers. The crash vehicles carry from 1,000 to 3,000 gallons of water/Aqueous Film-Forming Foam (AFFF) on board. Pumpers may carry 500 gallons of water and normally rely on hydrant connections to provide hose streams for fire extinguishment.

(2) Initial fire department response to a CCAS or VAFB hydrazine fire incident will, normally, rely on AFFF application by mobile crash vehicles, until hydrant-fed hand lines can be established. Then joint AFFF-water application can be considered by the on-scene senior fire officer. During the initial minutes of the response, the sole fire fighting capability will be the agent contained in the crash vehicle on-board tanks (1,000 - 3,000 gallons). Crash vehicle turret application rates are from 500 to 750 gallons per minute (GPM). Therefore, only a very few minutes of fire extinguishment time are available early-on for agent application on the fire. As has been previously discussed, both water and AFFF are minimally effective against hydrazine and oxidizer-enriched fires using currently-understood formulations and application rates.

c. Hydrazine Fire Response Scenario. Combining the factors described in subparagraph 3 a, above, the following scenario results to depict the significant shortcomings of the existing system:

(1) Fire fighters responding to a hydrazine or hydrazine derivative fire will have to deal with an almost invisible fire that produces little or no smoke. They will have extreme difficulty in determining where the fire boundaries are, the total fire size and the rate of fire spread. Unless there is an eyewitness account, it will be very difficult to pinpoint the source of the released fuel and the flow mechanism, such as gravity-fed or pressurized leaks. Application of AFFF from initial response vehicles may be very ineffective, since target range and position will be very difficult to judge without visual fire signatures. Once on-board stores of fire fighting agents are expended, vehicles must return to a water source for resupply, or must be connected to a nearby fire hydrant, which may or may not be available. During delays in agent application, reignition from hot metal surfaces or fire burn-back from foam decay can occur, or secondary fires involving collateral materials, vehicles or facilities may be ignited by the hydrazine fire. "Invisible" pockets of hydrazine fires will continue to burn until permanently extinguished or until the fuel source is depleted.

(2) Fire fighters on foot will be placed in additional danger, since they will not enjoy crash vehicle insulating safety and escape speed. With no smoke or flame coloration danger signals, fire fighters may impinge on the fire surface before they realize its location. The danger is compounded, since the fire fighters will not be aware of fire spread direction or rate caused by wind conditions or fuel flow. Note: Hydrogen fires also are colorless and smokeless. Workers in hydrogen refineries hold straw brooms out in front of them to locate suspected fires: when the broom ignites, one fire boundary is located.

(3) Rescue attempts will be similarly dangerous. Incomplete or partial extinguishment can leave several pocket fires in the path of rescue personnel. These will also be virtually invisible if hydrazines are involved. Fire fighters can unexpectedly enter a fire area they did not know was there on their way to or from a rescue site with or without a rescue victim in tow. Because of the usually windy conditions associated with the California and Florida coastal locations of USAF launch sites, such a situation would be extremely dangerous for larger fires in the 100 - 400 gallon or larger range.

(4) In summary, CCAS and VAFB fire fighters, today, must fight a hypergolic propellant fires using ineffective inventory fire fighting agents. This places the

fire fighter in increased jeopardy, and significantly increases the fire-loss risk to launch site facilities and, possibly, the launch vehicle and payload systems. Propellant fire consequences will depend on the location of the release point relative to launch systems or facilities, the speed and accuracy of fire identification and fire department response, and the effectiveness of fire fighting agents when applied by fire fighters in vehicles and at the end of hose lines.

4. Capabilities Required:

a. Requirement Definition.

(1) The fire departments at CCAS and VAFB require the identification or development and acquisition of a fire fighting agent that will provide the optimum combined fire extinguishment and vapor suppression performance for hypergolic fuel and oxidizer fire threats. The requirement is to test available, off-the-shelf firefighting agents and chemicals with known fire extinguishment properties to determine their relative effectiveness in hydrazine fire extinguishment and hypergolic (hydrazines and nitrogen tetroxide) propellant vapor suppression.

(2) Candidate agents are water, aqueous film-forming foams (AFFF), acrylic and protein-based foams, dry chemicals and gel-encapsulated dry powders. Required data includes optimum agent stream flow rates, application techniques, proportioning ratios and life cycle considerations (cost, availability, shelf life and new/modified dispensing equipment requirements).

(3) The end product will include technical documentation sufficient to permit the development of tactics and training for the optimum use of this agent or agents by the CCAS and VAFB fire departments.

(4) Increased hypergolic propellant fire extinguishment capability is the dominant performance parameter to be developed and fielded. Vapor suppression is a desired, but not mandatory capability. Since foam-water mixtures are effective fire fighting agents for hydrocarbon fires, it is anticipated they may be effective against hypergols. By their physical nature, foams also have some capabilities to blanket and suppress toxic liquid spill vapors. To account for this possibility, system performance parameters and the Requirements Correlation Matrix (RCM) for the required agent will include desirable vapor suppression characteristics.

(5) On the other hand, following the test and evaluation of the candidate agents listed above, the optimum fire fighting agent for hypergolic propellant fires may be a

dry chemical agent that exhibits no vapor suppression capability. In this possibility, CCAS and VAFB fire departments will have to assess the benefits of acquiring and supporting two separate agents for hypergol emergency response: one for fire extinguishment and one for toxic vapor suppression.

b. System Performance:

(1) Performance Parameters.

(a) The hypergolic propellant fire fighting agent or agents are intended for use in controlling and extinguishing fires fueled by hydrazine or its derivatives.

(b) The hypergolic propellant fire fighting agent or agents are intended for use in controlling and extinguishing NFPA Class A and Class B fires in which combustion is supported by nitrogen tetroxide.

(c) It is desirable that the hypergolic propellant fire fighting agent or agents be effective in controlling the toxic vapor hazard from releases of hypergolic propellants: hydrazine, its derivatives, and nitrogen tetroxide.

(d) The agent application time to extinguishment for a 100 square foot hypergolic fuel pool fire shall be 15 seconds.

(e) The agent application time to extinguishment for a 100 square foot hypergolic oxidizer-enriched hydrocarbon fuel pool fire shall be 15 seconds.

(f) The burnback time of a foam cover agent shall be 5 minutes.

(g) The post-fire or no fire vapor-securing capability of a foam cover agent shall be 1 ppm for hydrazine fuels and 10 ppm for nitrogen tetroxide.

(h) The minimum foam expansion ratio of a foam cover agent shall be 200.

(i) The minimum foam 25% drainage time of a foam cover agent shall be 4 minutes.

(j) The minimum foam 50% collapse time of a foam cover agent shall be 30 minutes.

(k) A foam cover agent shall pass the wand test specified in UL 162, "Standard For Foam Equipment and Liquid Concentrates".

(1) Hypergolic fire extinguishing agents may be water-based or a dry chemical current inventory fire extinguishing agents with or without hypergolic propellant fire suppression performance enhancement additives.

1. Water-based fire extinguishing agents and foams will be compatible with current inventory fire department vehicle agent storage and delivery components and equipment.

2. Hypergolic fire extinguishment performance additives for dry chemical-based fire extinguishing agents will be compatible and miscible with Sodium Bicarbonate (NSN-----) and Potassium Bicarbonate (NSN-----) agent formulations.

3. Hypergolic fire extinguishment performance additives for dry chemical-based fire extinguishing agents will not be susceptible to moisture absorption and/or caking inside the extinguisher or hose line to produce restricted or blocked flow.

(m) The hypergolic fire and vapor suppression agents or agent additives for both water-based and dry chemical agents will not produce, or cause to produce, toxic vapors while in their neat form or when mixed with water or dry chemical agent prior to its application to the hypergolic fire source.

(n) Should an effective hypergolic fire fighting agent or foam require the development and purchase of an agent/foam storage and distribution system, the following are required:

1 The system shall be mobile/towable by a 3/4 ton pickup truck.

2 The total pre-dispensed agent storage capacity shall be 500 gallons for a one-component agent. For a two-component agent, the storage capacity of each component shall be 250 gallons.

(o) Hypergolic fire fighting agents, foams and/or additives will produce the specified fire extinguishment and/or vapor suppression characteristics throughout the full range of operational temperatures associated with the effective application of the host agents. Required operating temperature ranges are:

1. For water-based agents: from + 34 to 140 °F.

2. For dry chemical agents: from TBD to 140 °F.

(2) SEEK EAGLE Requirements. Not Applicable.

c. Logistics and Readiness:

(1) A non-fire department inventory portable foam-dispensing system may require development and fielding to apply hypergolic fire or vapor suppression foam that cannot be dispensed through existing CCAS/VAFB fire department crash vehicles. For example previous tests of acrylic foams defined the requirement for a dispensing apparatus consisting of two pre-mix tanks, one for the gelling agent foam and water; and, one for the surfactant and water. Each pre-mix tank would flow product to a single proportioning valve from separate lines. The blend would then be dispensed from a foam-producing nozzle. A high pressure nitrogen injection system would be used to propel the foam the maximum throw distance.

(2) A preliminary concept of operations for a new mobile foam suppression system (if required) would be to pre-position one or several units at each fuel and oxidizer bulk storage area at CCAS and VAFB. Another two units would be pre-positioned inside each Titan launch complex: one at the Fuel Handling Area, and one at the Oxidizer Handling Area. These standby units would be charged and ready for operation by propellant transfer and/or fire department first responders. Several roving units would be available at each fire station on CCAS and VAFB to cover emergency response to spills or fires from standby or fall-back positions during dynamic propellant transfer operations. The total number/employment is TBD by AFSPC.

(3) Otherwise, AFFF or an enhanced foam formulation compatible with existing crash vehicles would be stored on board, as is currently done for AFFF.

(4) Operational Availability.

(a) Hypergolic propellant fire fighting and/or vapor suppression agents or agent additives for both water-based and dry chemical agents will have a storage shelf life of 5 years or greater.

(b) Dispensing systems/foam carts for hypergolic propellant fire fighting and/or vapor suppression agents, if required, shall be engineered and constructed to permit system availability of 99 percent over a mission time of two years. This level of availability is attainable with appropriate system design considerations of modularity and maintenance engineering.

(c) Mean Time Between Maintenance. TBD.

(d) Mean Repair Time. TBD.

(e) Expected Maintenance and Manpower Skill Levels. Hypergolic propellant fire fighting and/or vapor suppression agents and dispensing systems shall require no increase in CCAS/VAFB fire department extinguisher maintenance or facility support contractor personnel equivalent manpower. The system shall be maintainable by 3- and 5-skill level technicians. Manufacturer's contract maintenance and CCAS/VAFB launch support contractor maintenance options shall be considered during system life cycle cost analysis and acquisition approach planning.

(5) Logistics Supportability And Readiness Requirements.

(a) The hypergolic propellant fire fighting and/or vapor suppression agents and dispensing systems will be logistically-supportable by CCAS and VAFB base supply organizations and systems. Contract maintenance is TBD.

(b) Agents and agent dispensing systems shall be operable and maintainable under the CCAS and VAFB design climactic conditions of temperature, humidity, rain, and sea salt spray for exterior electronic systems.

(c) The required dry storage temperature range for hypergolic fire fighting and /or vapor suppression agents or agent additives are:

1. Water-based agents: from + 34 to 140 °F.

2. Dry chemical agents: from - TBD to 140 °F.

(d) The maximum size of the hypergolic propellant fire fighting and/or vapor suppression agents or agent additive bulk container shall be 5 gallons for a liquid agent or agent additive and 50 pounds for a dry chemical agent additive.

(e) The hypergolic propellant agent additives that are to be added to existing foam or dry chemical agents to enhance hypergol fire extinguishment or vapor suppression performance, will be compatible with fire fighting vehicle storage tank materials and the materials of the associated agent dispensing, hose and turret systems.

(f) The container systems for hypergolic propellant fire fighting and/or vapor suppression agents or agent additives will include provisions for rapid field-filling of fire vehicle or foam dispensing apparatus on-board storage tanks under operational fire fighting

conditions. Each container shall include a filling spout that can be rapidly attached to the main access port and an air vent port with removable cap. Containers will be similar in design to portable, commercial 5-gallon gasoline tanks with built-in handles and telescoping or internally-stored pouring spouts.

d. Critical System Characteristics

(1) Mandatory Characteristics.

(a) Expected Mission Capability. Hypergolic propellant fire fighting and/or vapor suppression agents or agent additives will decrease fire extinguishment time, increase burnback resistance and decrease vapor emissions from hypergolic propellant fires and/or liquid chemical pools.

(b) Electronic Counter-Countermeasures (ECCM) and Wartime Reserve Modes (WARM) Requirements. Not Applicable.

(c) Conventional, Initial Nuclear Weapons Effects, Nuclear, Biological, and Chemical Survivability. Not Applicable.

(d) Environmental Factors. Hypergolic propellant fire fighting and/or vapor suppression agents or agent additives and any required storage/delivery systems will be capable of all required performance characteristics under all climatic and temperature conditions expected at CCAS and VAFB.

1 Operational temperature ranges are:

a For water-based agents or agent additives: from + 34 to + 140 °F.

b For non-water-based agents and foams, or agent additives: from + 34 to +140 °F.

c For dry chemical agents or agent additives: from TBD to + 140 °F.

d For agent delivery systems: from TBD to +140 °F.

2 Agent storage and dispensing systems must incorporate appropriate environmental storage control systems and fabrication materials to prevent system damage from cold, heat, humidity or thermal expansion.

3 Materials used in the fabrication of storage and dispensing systems will not support the growth of fungi to the best commercial practices.

4 Dispensing system performance capabilities will not be adversely affected by wind-blown dust, sand or sea salt spray.

5 Dispensing system components will withstand the UV effects of sunlight with minimal material degradation for the system service life.

6 Environmental requirements for weather seals, air tightness, humidity, marine atmosphere, low temperature, temperature shock, heat transfer, blowing sand, dust, UV effects, solar loads and water tightness shall be IAW MIL-STD-810E.

(e) Electromagnetic Compatibility and Frequency Spectrum Assignment. Not applicable.

(f) Safety Parameters.

1. Fire extinguishing and vapor suppression agents or agent additives must be safe to store and use throughout their life cycle.

2. The use of fire extinguishing and vapor suppression agents or agent additives must not produce combustion products that are more toxic than those associated with the fire itself.

3 A safety hazard analysis must be conducted IAW MIL-STD-882C and MIL-STD-1472D to include, but not limited to, hazards inherent in the design, construction, testing and operational employment of an agent storage and dispensing system (if required).

(2) Security.

(a) Owner/user security applies IAW AFI 31-209. Security is provided by the facility/property protection standards associated with each location where agents and dispensing systems are stored and employed, and the security classification of the launch vehicle and payload systems. Additional security considerations are not required.

(b) A program protection plan for agent/foam dispensing systems, if required, will be developed IAW AFPD 31-7.

(3) Electronic Counter-Countermeasures. Not applicable.

(4) Software Engineering. Not applicable.

5. Integrated Logistics Support:

An ILSP is not required. Existing logistics support for fire extinguishing agents and chemicals shall be applied to the new agent (s).

a. Maintenance Planning. An ILSP is not required. Existing logistics support for fire fighting agents and fire extinguisher systems shall be applied. No additional logistics support is required.

(1) All components of the mobile agent storage/delivery system, if required, must be easily assembled, installed and maintained. Existing tools, test measurement and diagnostic equipment (TMDE), and/or presently approved, emerging TMDE or support equipment will be used.

(2) Maintenance and repair will be accomplished at the fire department or facility support O&M organizational level. Periodic inspections and preventive maintenance tasks will be programmed to ensure operational status.

(3) The level of replacement shall be at the major component level.

(4) The level of repair shall include only manufacturer-identified components or subsystems. All other items shall be repaired by replacement.

(5) Maintenance Requirements For On- and Off-Equipment Maintenance. TBD.

(6) Time-Phased Depot Requirements. Not Applicable.

(7) Organic Support Capabilities. TBD

(8) Depot Tasks and Capabilities Required. None.

b. Support Equipment.

(1) Standard Support Equipment. Hypergolic agent and/or foam storage and dispensing systems will be self-contained and require no additional support equipment.

(2) Depot level Support Equipment. Not applicable.

c. Human Systems Integration (HSI):

(1) Operational And Maintenance Training Concept. Training for the addition of new agents to fire fighting vehicles and extinguisher systems will be conducted by the CCAS and VAFB fire department training organizations. Performance and handling data to be used for training materials will be documented during the agent's development test and evaluation (DT&E). No additional training support is required.

(2) Manpower, Personnel And Training Constraints. No additional manpower is required for training, maintenance or employment of the new agent (s).

(3) Human Performance/Human-In-Loop Issues.

(a) Using Command.

1. Manpower, Personnel, Training, Safety, Human Factors Engineering, and Health Hazards Constraints.

a Containers for agents and/or agent additives will be designed for ease and speed of lifting/carrying and field-filling into fire vehicle on-board water storage tanks with minimum spillage.

b IAW DODI 5000.2/AF Sup 1, MIL-STD 1472D, and MIL-STD-882C, a system safety analysis is required as a part of this development effort to ensure all tasks associated with the preparation, mixing, application, and cleanup of hypergolic propellant agents or agent additives, hypergolic vapor suppression foams and any required agent or foam-dispensing system can be performed by all personnel. Particular attention should be given to hazard analyses for both testing and operational use and support of these agents and/or systems.

c Agent/foam storage and dispensing systems must not present undesirable or uncontrolled ergonomic hazards to personnel, nor will it create any hazards from its configuration or the materials of construction used.

2. Maintenance and Training Concepts. Described in Paragraph 5c.

(b) Supporting Command.

1 Manpower Requirements For Depot Maintenance, Engineering, and Material Management. None.

2 Depot Training Requirements. None.

(4) Participating Command Manpower Requirements. Additional manpower is not required.

(5) Training and Training Support.

(a) Operational training Tasks. To be determined by the CCAS and VAFB fire department training officers.

(b) Maintenance Training Tasks. To be determined by the CCAS and VAFB fire department or by facility O&M support contractor fire extinguisher maintenance technicians. Determinations shall be made in cognizance of the agent/foam dispensing system manufacturer's technical support data on system operation, maintenance and repair.

(c) Training Support For Required Operational Capabilities and Maintenance Requirements. None.

(d) Airspace and Range Training Requirements. Not applicable.

d. Computer Resources. Not Applicable.

e. Other Logistics Considerations.

(1) Supply Support.

(a) The hypergolic agents, agent additives, vapor suppression chemicals and agent/foam storage and dispensing equipment shall not require special storage or storage equipment.

(b) The hypergolic agents, agent additives, and/or vapor suppression chemicals shall be added to the CCAS and VAFB fire fighting agent bench stock systems, in accordance with the chemical classification assigned to the agent (s) following its final formulation, development and testing.

(c) CCAS and VAFB fire departments will be provisioned for agents/chemicals and agent/foam storage and delivery systems (if required) through standard USAF logistics channels. No special supply support will be required.

(d) Replacement quantities shall be added to the CCAS and VAFB facility O&M organizational/contract bench stock systems, in accordance with the shelf life and maintenance specifications of the manufacturers and training use expenditure rates.

(e) Equipment and component spares for agent/foam storage and delivery systems will be identified in a repair-level analysis. They must be obtained and stocked at the base level as part of the purchase contract IAW AFI 10-602. Spares provisioning will be accomplished within 90 days after systems pass first article acceptance testing.

(f) Packaging, Handling and Transportation (PH&T).

1. PH&T requirements must be developed and implemented IAW the AFI 24-series directives. Requirements will be consistent with the program schedule and will be interfaced with other ILS elements.

2. Agents, foams or agent will be containerized so they will not be adversely affected by prolonged storage under any climatic conditions.

3. Agents, foams and/or additives will include features for rapid field-filling of fire vehicle agent tanks IAW Paragraph 4b(7&8).

4. Agents, foams, additives and/or storage and delivery systems will be packaged to withstand expected shocks of transportation and handling IAW MIL-STD-810E.

5. Agents, foams and/or additives shall be packaged so they will not be adversely affected by prolonged storage under any climatic conditions.

(g) Preservation, packing and packaging for agents, foams and/or additives shall be designed to commercial fire extinguishing agent industry standards and shall provide the degree of protection and handling provisions necessary based on the characteristics of the item and its source, destination, storage and mode of transportation. Similarly, preservation, packing and packaging for the agent/foam storage and dispensing system (if required) shall be designed and provide protection and handling provisions based on commercial fire apparatus standards and specifications.

(h) Provisioning Strategy. Fire departments shall use normal USAF and/or base support O&M supply channels and procedures.

(2) Technical Data.

(a) Required technical data for agents, foams and/or additives will include the chemical additive manufacturer's Material Safety Data Sheet (MSDS) and the final DT&E Test Report (s).

(b) Technical data for agents, foams and/or additives will be fully validated by the Air Force during a demonstration by the manufacturer of agent performance in live hydrazine fires conducted at the NASA hypergol fire training facility at CCAS.

(c) Technical data for agents, foams and/or additives shall include appropriate mixing ratios for various application techniques, proper dispensing rates, areas of coverage per unit volume dispensed, and proper storage, handling and cleanup procedures.

(d) Technical data for agents, foams and/or additives shall include an environmental assessment of the consequences of the additive agent when released to both air and ground environments.

(e) Technical manuals for operating and maintaining the agent/foam storage and dispensing system and system components will be provided by the manufacturer. These manuals and other related technical data will be fully validated by the Air Force during a demonstration by the manufacturer of an initial prototype system at CCAS or VAFB.

(f) Agent/foam storage and dispensing system technical manuals shall include an appropriate technical and functional description of the system and its components. Data shall include system installation, operation and maintenance, refurbishment of detectors, RF transmitters and logic controllers. Logic controller software and detector calibration/sensitivity data also shall be fully documented.

(g) Production drawings and component schematics of the agent/foam storage and dispensing system shall be provided.

(3) Facilities And Land. The hypergolic agent/foam storage and dispensing system (if required) and improved hypergolic propellant fire fighting agents/foams and/or agent additives will be stored in existing CCAS and VAFB supply warehouses, fire department bench stock areas, fire department apparatus storage areas, and at pre-positioned hypergolic propellant fire hazard locations.

(4) Logistics Support Analysis (LSA). Requirements are TBD, however, preparation of a LSA is not anticipated.

(5) Hazardous Materials.

(a) Developers of improved hypergolic propellant fire fighting agents/foams and/or agent additives shall minimize the use of toxic or hazardous chemicals to produce the required fire extinguishment and/or vapor

suppression performance characteristics. As a goal, no toxic or hazardous chemicals shall be used.

(b) Agent/foam storage and dispensing system design and construction will minimize the use of hazardous materials in production. Magnesium and magnesium alloys shall not be used.

(6) Computer-Aided Acquisition Logistics Support (CALS). Requirements are TBD.

(7) Supporting Command Requirements.

(a) Additional Depot Facilities. None required.

(b) Special Handling, Storage and Transportation Requirements. None required.

(c) Engineering Data and Rights. Proprietary ownership of the hypergolic agent/foam storage and dispensing system design (if required) and chemical formulations for improved hypergolic propellant fire fighting agents/foams and/or agent additives is anticipated and may be retained by the respective manufacturers. However, ownership of the formulas should revert to the Government in the event an owner discontinues the product line or ceases to exist. The Government should have the right to purchase the any chemical formula.

(d) Depot and System Technical Order Requirements.

1 No depot-level TOs are required.

2 System TOs governing the operation and maintenance of the hypergolic agent/foam storage and dispensing system (if required) will be provided by the manufacturer. Specific TO requirements are TBD.

(e) Disposal of Hazardous Waste. TBD. Improved hypergolic propellant fire fighting agents/foams and/or agent additives will minimize the use of hazardous chemicals. Should a final formula be classified as hazardous, disposal shall be in accordance with existing CCAS and VAFB disposal by contract programs.

(f) Special Force Management Concepts. Not applicable.

(g) Plans For Advanced technology. Not Applicable.

(h) Configuration Control Concepts. TBD for the hypergolic agent/foam storage and dispensing system (if required).

(i) Spares Strategies. LRU spares for the hypergolic agent/foam storage and dispensing system (if required) will be provided at the base/unit/base support O&M contractor level.

(j) Sustaining Engineering. Engineering support shall be provided by the prime contractors selected to manufacture the hypergolic agent/foam storage and dispensing system (if required) and each chemical formulation for an improved hypergolic propellant fire fighting agent/foam and/or agent additive.

(k) System Warranties and Guaranties.

1 Improved hypergolic propellant fire fighting agents/foams and/or agent additives shall include a manufacturer's warranty for specified performance during its guaranteed shelf life period that is easily administered and is consistent with the agent/foam/additive's performance specifications.

2 The hypergolic agent/foam storage and dispensing system (if required) shall include a manufacturer's warranty that is easily administered and is consistent with the system maintenance concept.

3 Warranties must be cost-beneficial and include the selected essential performance requirements. The development and approval of the warranty plan must be accomplished not later than 6 months after the award of the contract for engineering and manufacturing development.

4 Warranty Administration. The body of the warranty must describe, in detail, the specific requirements to administer the warranty. The administration section of the warranty plan will identify the administrative requirements. This section also must identify and assign responsibilities for processing warranty claims, for item disposition from CCAS/VAFB to the manufacturer chemical production for disposal. The administration plan also must describe the exact method of determining non-compliance with additive performance specifications and/or shelf life deterioration. It is essential that the selected operational performance and shelf life requirements defined in the contract specifications be measurable by standard USAF data collecting systems to prevent the warranty from being unmeasurable and, consequently, unenforceable.

5 Warranty Policy. DOD policy is to obtain only warranties that are cost-effective. Cost-benefit analysis methodologies must be used and a summary of the results provided to AFSPC/CE to determine if the proposed warranty is cost-effective and to provide the documentation necessary to process a waiver, should the warranty not be cost-effective.

(l) Environmental Stress Screening. Not Applicable.

(m) Postfielding Data Collection Efforts. TBD.

(8) Information Needs. No special or additional directives or forms are required to support the addition of new chemicals or fire fighting apparatus to the USAF supply inventory.

6. Infrastructure Support And Interoperability:

a. Command, Control, Communications And Intelligence. Not Applicable.

b. Transportation And Basing.

(1) The containers holding improved hypergolic propellant fire fighting agents/foams and/or agent additives will be land transportable.

(2) The hypergolic agent/foam storage and dispensing system (if required) must be towable by a 3/4 ton pickup truck.

c. Standardization, Interoperability, And Commonality.

(1) Chemicals comprising improved hypergolic propellant fire fighting agents/foams and/or agent additives will be compatible with DOD, other federal and municipal fire fighting vehicles and portable fire extinguishers worldwide.

(2) Joint Potential Designation. TBD. Developed agents/foams and the hypergolic agent/foam storage and dispensing system (if required) will be commercially available for purchase by any DOD, other federal and municipal fire service organization with a hydrazine fire response mission requirement.

d. Mapping, Charting And Geodesy Support. Not Applicable.

e. Environmental Support. Not Applicable.

7. Force Structure.

a. Dry Chemical And Water-Based Agents/Foams/Additives Base Stock Level Requirements.

(1) The AFSPC ready storage initial purchase quantity of a selected agent/foam shall be the amount to fully charge all selected fire department crash vehicles and/or delivery systems that will be employed in hypergolic fire fighting response at CCAS and VAFB.

(2) Additionally, each fire department shall store 3X this quantity at the unit bench stock location. Furthermore, each base supply warehouse shall store a like 3X quantity. Total on-base storage of agents/foams shall not be less than 6X the in-vehicle/system ready storage amount.

(3) The total initial quantity to be purchased is 7X the ready storage amount.

b. Dry Chemical Agents/Additives Configuration Estimate. The estimated total AFSPC initial purchase quantity of additives to improve the hydrazine fire extinguishment performance of dry chemical fire extinguishers is 7,000 pounds, or 3,500 pounds each for CCAS and VAFB. The single base rationale for this quantity is as follows:

(1) Number of 20-pound, hand-held extinguishers requiring additive: 50

(2) Number of wheeled, 150-pound extinguishers requiring additive = 10

(3) Per base ready in-extinguisher required quantity based on maximum 20% required concentration: $0.20 \times ([20 \times 50] + [150 \times 10]) = 500$ pounds.

(4) Total AFSPC initial purchase quantity = $2 \times 500 \times 7X = 7,000$ pounds.

c. Water-Based Agent And Agent/Foam Delivery System Configuration Estimate.

Location	No. Units	Each Unit On-Board Water (Gal)	Each Unit On-Board Agent (Gal)	All Units Agent Total (Gal)
CCAS Fire Department				
P-23	1	3,000	500	500
P-19	3	1,000	130	390
P-4	2	1,500	180	360
VAFB Fire Department				
P-23	3	3,000	500	1,500
P-19	1	1,000	130	130
CCAS Prepositioned Foam/Agent Storage & Delivery Systems				
Bulk Fuel Storage Area	2	450	50	100
Bulk Oxidizer Storage Area	2	450	50	100
Titan Fuel Handling Area	2	450	50	100
Titan Oxidizer Holding Area	2	450	50	100
Delta Stage II Fuel & Oxidizer Loading Area	2	450	50	100
Fire Department Mobile Units	2	450	50	100
VAFB Prepositioned Foam/Agent Storage & Delivery Systems				
Bulk Fuel Storage Area	2	450	50	100
Bulk Oxidizer Storage Area	2	450	50	100
Titan Fuel Handling Area	2	450	50	100
Titan Oxidizer Holding Area	2	450	50	100
Delta Stage II Fuel & Oxidizer Loading Area	2	450	50	100
Fire Department Mobile Units	2	450	50	100

New Foam/Agent Total Systems	24			
Maximum Crash Vehicle Agent Ready Inventory (Gallons)				3,380
Total Agent/Foam Ready Inventory (Gal)				1,200
Total Crash Vehicle Agent Initial Purchase (Ready Inventory + 6X) {Gallons}				23,660
Total Agent/Foam New System Initial Purchase (Ready Inventory + 6X) {Gal}				8,400

8. Schedule Considerations:

a. IOC/FOC will be attained upon delivery of the required initial inventory of hypergolic fire extinguishing agents/foams quantities and foam/agent storage and delivery systems to CCAS and VAFB fire departments.

b. The development, testing and acquisition of the specified agents and delivery systems (if required) are urgently required to permit safe and effective fire fighting and rescue operations at CCAS and VAFB in the event of a significant hypergolic propellant release and fire.

c. Required IOC Date: FY 98.

2 Atch

1. Requirements Correlation Matrix
2. Hazard Scenario Summary

REQUIREMENTS CORRELATION MATRIX

As Of Date:

PART I

SYSTEM CAPABILITIES AND CHARACTERISTICS	ORD I		ORD II		ORD III	
	Thresholds	Objectives	Thresholds	Objectives	Thresholds	Objectives
1. Clean Room Flame Detection: N2H4 & MMH *	6" Burner Flame At 50-Ft Range	6" Burner Flame At 50-Ft Range				
2. A-50 Bulk Storage & Transfer Facility Flame Detection *	1-SF Pan Fire At 100-Ft Range	1-SF Pan Fire At 100-Ft Range				
3. Hypergolic Fuel Container Maintenance Facility Flame Detection: A-50, MMH, UDMH & N2O4 *	1-SF Pan Fire At 100-Ft Range	1-SF Pan Fire At 100-Ft Range				
4. Detector Field Of View (All Flames) *	90 Conical Degrees	90 Conical Degrees				
5. Detection System Response Time For 6" Burner Flame At 50-Ft And 1-SF Pan Fire At 100-Ft *	< 1.0 Second	< 1.0 Second				
6. False-Alarm Immunity *	Sunlight Welding Lighting Systems Hot Motors/ Exhausts Lightning/ Weather RF Emissions EMP	Sunlight Welding Lighting Systems Hot Motors/ Exhausts Lightning/ Weather RF Emissions EMP				

Note 1: An * Denotes An Item To Be Placed In The APB As A Key Parameter

FLAMERCM

REQUIREMENTS CORRELATION MATRIX
Part II

(Supporting Rationale for System Characteristics and Capabilities)

AS OF DATE:

Parameter 1 - Agent Application Time To Extinguish A 100 Square Foot Hypergolic Fuel Fire. Hydrazine fires are more intense and produce higher temperatures than those associated with hydrocarbon fuels. Minimum extinguishment performance for this repeatable test is required to ensure the selected agent (s) will perform satisfactorily under actual fire site conditions and fuel loadings. Hazard analyses for CCAS and VAFB propellant transportation and transfer operations indicate that accidental hydrazine releases can be expected in the 1 to 400 gallon range. Should a fire result, the hydrazine spill surface area could be as much as 3,000 to 5,000 square feet, depending on the spill surface material roughness and runoff gradients. Data gained from the specified 100 square foot extinguishment tests, such as agent application rate and total volume of agent used, will be scaled to expected site conditions and fire department delivery apparatus capabilities.

Parameter 2 - Agent Application Time To Extinguish A 100 Square Foot Hypergolic Oxidizer-Enriched Hydrocarbon Fuel Fire. Hazard analyses for CCAS and VAFB oxidizer transportation and transfer operations indicate that the primary emergency consequence of an accidental N_2O_4 release will be the toxic vapor threat. However, should the released oxidizers come in contact with wood, paper or hydrocarbon fuels, spontaneous ignition can occur. These fires will burn "whiter" and will produce higher temperatures than those associated with hydrocarbon fuels alone. Minimum extinguishment performance for this repeatable test is required to ensure the selected agent (s) will perform satisfactorily under actual fire site conditions and oxidizer-fuel loadings. Accidental oxidizer releases can be expected in the 1 to 400 gallon range. Should a fire result, the N_2O_4 spill surface area could be as much as 3,000 to 5,000 square feet, depending on the spill surface material roughness and runoff gradients. Data gained from the specified 100 square foot extinguishment tests, such as agent application rate and total volume of agent expended, will be scaled to expected site conditions and to fire department delivery apparatus capabilities.

Parameter 3 - Minimum Foam Agent Burnback Time. This parameter is required to ensure that a foam-based fire fighting agent has sufficient extinguishment strength and longevity to permit full extinguishment of the entire fire surface area without reignition. Actual chemical spills on grass and irregular hard surfaces normally result in a discontinuous fuel fire surface. Foam agent application by fire fighters causes progressive extinguishment of the fire area as the foam is applied. Low burnback-resistant foams break down rapidly and permit fuel surface vapors to escape. These can reignite from the remaining fire column, or from contact with hot metal surfaces. Burn back negates the effects of the initial extinguishment effort, wastes valuable agent and places fire fighters and property at additional risk.

Parameter 4 - Minimum Foam Agent Vapor Seal Performance. Once hydrazine fires are extinguished, the remaining fuel column continues to off-gas toxic and highly flammable vapors. Similarly, an oxidizer spill, while not expected to result in a fire situation, is an extremely hazardous toxic chemical release. It is desirable that a single foam-type fire fighting agent that is effective in extinguishment performance, also be effective as a vapor suppression blanket. Such performance will minimize the environmental impact of the incident and the vapor threat to life within the toxic vapor plume.

Parameter 5 - Minimum Foam Agent Expansion Ratio. CCAS and VAFB fire departments will have limited agent quantities on site and in reserve to combat a hydrazine or oxidizer fire/spill situation. Therefore, it is required that a foam agent provide coverage of a large a fire surface area as is possible. The foam expansion ratio defines the required increase in volume from the original foam constituent parts, usually liquids, to the final volume of the foam structure. This ratio is used to compute the required ready volume of foam agent required at each hazard site to ensure full coverage and extinguishment of the target threat fire condition.

Parameter 6 - Minimum Foam Agent 25% Drainage Time. This parameter measures short-term foam quality and stability. Foam drainage occurs when the foam structure breaks down into its liquid solution state. The longer the time for 25% drainage, the more durable and stable the foam for fire extinguishment and vapor suppression applications.

Parameter 7 - Minimum Foam Agent 50% Collapse Time. This parameter measures long-term foam quality and stability in terms of the volume of foam remaining after generation as a function of time. The longer the time for 50% collapse, the more durable and stable the foam for fire extinguishment and vapor suppression applications.

Parameter 8 - Foam Agent Storage and Delivery System. The best agent for hypergolic fire fighting and/or vapor suppression at CCAS/VAFB identified by this development effort may not be compatible with existing fire crash vehicle on-board storage and turret delivery systems. Foams that can structurally withstand the intense heat effects of hydrazine fires and combat the reactive nature of hypergols to blanket vapors without breakdown may require generation by mixture of two or more reactive chemicals. Such foams require separate component storage tanks and accurate proportioning systems to provide the proper mixture at the application nozzle. Thus, a unique storage and delivery system will require development, testing and manufacture should such a foam be selected for fielding. This system will insure the effective application of the foam agent at CCAS and VAFB hypergolic fire and spill threat locations. The system must be towable by small, fire department utility vehicles. Additionally, it must have a minimum agent capacity of 500 gallons to ensure adequate coverage and performance against CCAS/VAFB probable hypergolic fire and/or spill incident scenarios.

Parameter 9 - Operational Temperature Range. This development will provide an increased capability agent (s) to enhance fire suppression and rescue operations at the CCAS/VAFB space launch and launch support facilities. Agents/foam components most likely will be premixed with the water supplies of crash vehicles or the agent storage and delivery system described above, if it is required. All such chemicals must be effective for water temperatures in the specified above-freezing temperature range. Similarly, the dry chemical additive must remain effective over the entire performance range of this class of extinguishers, as specified.

Parameter 10 - Non-Hazardous Agent/Foam/Additive Constituent Chemicals. Agents and additives will be pre-mixed and placed in vehicle/system storage containers by fire fighters prior to and during fire fighting operations. Following application, agents and foams will literally blanket the area surrounding the fire surface and may be absorbed into the soil mass. It is imperative these chemicals do not increase the environmental above that which occurs from the hypergolic propellant release incident. They should be non-hazardous to fire fighters by skin contact and vapor inhalation routes, non-ozone depleting, and non-global warming. It is desirable that they be biodegradable within TBD months when absorbed by Florida and California soil and exposed to the corresponding launch site weather conditions.

Parameter 11- Storage Shelf Life. A minimum agent/foam/additive 5 to 10-year storage shelf life is required to minimize life cycle cost and material supportability requirements.

Parameter 12 - Agent/Foam/Additive Bulk Storage Container Requirements. Water-based agents, foams and/or additives normally will be pre-mixed or carried in crash vehicle, pumper or developmental foam/agent deliver system on-board water/agent storage tanks. These ready storage quantities will provide the initial fire and/or vapor suppression capabilities at the hypergolic propellant incident site. Additional refills may be required after the initial foam/agent/additive supply has been expended on the fire or spill pool. This fill action would be conducted at the emergency response site. Therefore, the container system for these chemicals must include provisions for rapid field-filling of fire apparatus/vehicle/system's on-board storage tanks under operational fire fighting conditions. They should be similar in design to portable, commercial 5-gallon gasoline tanks with built-in handles and telescoping or internally-stored pouring spouts.

CCAS/VAFB HYPERGOLIC PROPELLANT HAZARD SCENARIO SUMMARY

RELEASE SITUATION	RELEASE MECHANISM	MATERIAL RELEASED	CREDIBLE RELEASE (GAL)		FIRE DEPARTMENT CONSEQUENCES
			MINOR	MAJOR	
PROPELLANT SAMPLING ACCIDENT	OVERFILLED/DROPPED SAMPLE FLASK HOSE/CONNECTION LEAK	N2O4 N2H4 A-50 MMH	0.03	0.25	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
PROPELLANT CONTAINER/TANKER MAINTENANCE ACCIDENT	UNDETECTED RESIDUAL RELEASED DURING TEAR-DOWN	N2O4 N2H4 A-50 MMH	0.25	0.25	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
ROADWAY TRANSPORTATION VEHICLE ACCIDENT W/ CONTAINERS OR TRAILERS	WELD BREAK WALL PENETRATION LEAKING CONNECTION STEM	N2O4 N2H4 A-50 MMH	7.5 - 12.0	55 - 120	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
DROPPED CONTAINER - LOADING/UNLOADING ACCIDENT	WELD BREAK WALL PENETRATION LEAKING CONNECTION STEM	N2O4 N2H4 MMH	7.5	12.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
ROADWAY VEHICLE ACCIDENT W/GLASS & HOKE BOTTLE SAMPLES	BROKEN GLASS BOTTLE LEAKING HOKE BOTTLE	N2O4 N2H4 A-50 MMH	0.25	1.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
TRANSPORTATION OR PAYLOAD MATING ACCIDENT W/ FUELED SATELLITE	SHOCK-INDUCED LEAK FUEL TANK PENETRATION	N2O4 N2H4 MMH	7.5	12.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
BULK HYPERGOL STORAGE TANK LOAD OR OFFLOAD ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.27	200	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			7.34	300	
LAUNCH VEHICLE FHA/OHA/UT FUEL/DEFUEL ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.84	40	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			23.13	400	
PAYLOAD PROCESSING FACILITY INCIDENT DURING SATELLITE FUELING/TESTING	CONNECTION LEAK MINOR HOSE FAILURE	N2O4 N2H4 MMH	0.06	1.0	FUEL SPILL RESPONSE OXIDIZER SPILL RESPONSE

PORTABLE PROPELLANT CONTAINER SUMMARY

- | | |
|--|------------------------------------|
| ● 55 GAL DRUMS (LEAST SAFE) | ● VAFB/VENDOR 5,000 GAL TANKERS |
| ● KSC 5/30 GAL DOT/ASME DRAIN CONTAINERS | ● KSC 500 GAL GPTU |
| ● SA-ALC 2,000 LB CYLINDERS | ● KSC/VENDOR 2,500 GAL TANKERS |
| ● PROGRAM-SPECIFIC GSE CARTS | ● 10,000 GAL RAIL CARS (MOST SAFE) |

ORDATCH2

APPENDIX F

PURCHASE DESCRIPTION (PD) FOR A LAUNCH TOWER EMERGENCY
ESCAPE CHUTE

**PURCHASE DESCRIPTION (PD)
FOR A
LAUNCH TOWER EMERGENCY ESCAPE CHUTE**

1. Launch Tower Hazardous Operations.

a. Space vehicle launch and payload processing facilities at Cape Canaveral Air Station, Florida (CCAS) and at Vandenberg Air Force Base, California (VAFB) support all major United States Air Force (USAF) and commercial satellite space launch operations. These facilities support systems and processes that involve the storage and transfer of highly flammable, explosive and toxic hydrazine fuels.

b. Universal Environmental Shelters (UES) are constructed on the higher levels of launch pad Mobile Service Towers (MST). They encircle the upper stages and payloads to provide protected access for final servicing, checkout, and propellant loading. Clean rooms are provided where access to payloads and/or fuel transfer ports are required and system contamination must be prevented. These facilities are located at elevations over 100 feet above ground level.

c. Typical hazardous operations that are conducted in elevated launch tower clean room facilities include satellite and Centaur upper stage reaction control system (RCS) fueling. For monopropellant payloads and boosters, anhydrous or monomethylhydrazine is transferred from 55-gallon drums, NASA drain containers or payload specific GSE to the on-board storage tanks via propellant transfer units (PTUs) and conditioning panels. Fuel capacities range from 40 gallons for the Centaur to several hundred gallons for large satellite systems. Some payloads may include a dual-propellant RCS. In this case, a separate oxidizer (nitrogen tetroxide) loading operation is conducted inside the clean room.

d. Hazardous clean room propellant transfer operations are conducted by a small cadre of engineers, technicians and safety professionals. Typically, no more than six personnel are required to conduct a fueling task. Since hypergolic propellants are extremely toxic chemicals, all personnel inside the clean room during fueling or defueling operations are protected by NASA-developed Self-Contained Atmospheric Protective Ensembles (SCAPE). Breathing air for personnel in SCAPE is provided by a tether from a central source. Emergency air supplies are provided by portable bottles that are carried by each individual.

e. Propellant transfer operations are conducted following strict procedures and protocols to minimize the potential for accidental release. Fuel transfer lines are wrapped in shrouds and transfer equipment is set in stainless steel drip pans to contain incidental vapor or liquid releases. Emergency ventilation systems and air aspirators are available to prevent larger releases from reaching an explosive vapor concentration level (lower explosive limit). Portable vapor detection systems are used to monitor potential leak locations and provide an early indication of an equipment malfunction or material failure.

2. Threat.

a. Hydrazine-based fuels are found in very large bulk quantities only at CCAS and VAFB. Anhydrous hydrazine, AH (N_2H_4), and its derivative, monomethylhydrazine, MMH (CH_6N_2), are extremely toxic by inhalation and skin contact routes. They spontaneously and violently react when contacted with oxides, such as rust, dust and debris, flame or spark.

b. Hydrazines burn at a rate that is about 10 times as fast as a hydrocarbon fuel fire. Therefore, a propellant fire is more intense and spreads faster. Additionally, hydrazine fires are virtually colorless and smokeless. This is because the carbon-based compounds that are contained in and produced by jet or automotive fuel fires are not present in hydrazines to produce black smoke and the characteristic yellow-orange flame.

c. Technicians involved in hypergolic propellant fuel operations wear SCAPE, which are fully-encapsulated protective ensembles. These include vision-restricting helmets. Because of the near-invisible nature of hydrazine flames and limited fields of vision, these personnel have extreme difficulties in identifying the location and size of a hydrazine fire, its rate of growth, and direction of spread. A hydrazine fire can remain undetected until other warning signs become recognizable, such as the melting of SCAPE suits, vapor detector alarms, or the combustion of other materials in the clean room that would produce a recognizable smoke or flame color signature.

d. The accidental release of hydrazine fuel inside a clean room hydrazine can result in explosion, fire or both. Fire spread and damage to propellant storage tanks on board satellites or booster vehicles and/or to bulk transfer drums or storage carts also are possible. Fire spread outside the clean room could involve upper stage unit propellants and the core lift vehicle with both internal fuel supplies and external solid rocket booster components.

e. Other threat conditions in launch tower clean rooms and other areas have the potential for the release of propellants and fire. These include fueled payload mating operations to the core vehicle, payload fuel system malfunctions and on-board electrical malfunctions/fires in the proximity of pressurized fuel system components.

3. Current Emergency Evacuation Scenario.

a. Depending on the launch tower involved (Atlas, Delta & Titan) and the base location (Cape Canaveral & Vandenberg), emergency egress will be limited to one or two open stairwells located on the exterior of the MST superstructure. Escaping personnel will be attired in SCAPE and must carry their own emergency air supply bottles. Injured personnel and their air supplies must be litter-carried or fireman-carried by another member of the clean room crew to ground level. The requirement to carry both the injured and their air supplies, plus the rescuer's air supply bottle(s), greatly complicates the rescue scenario.

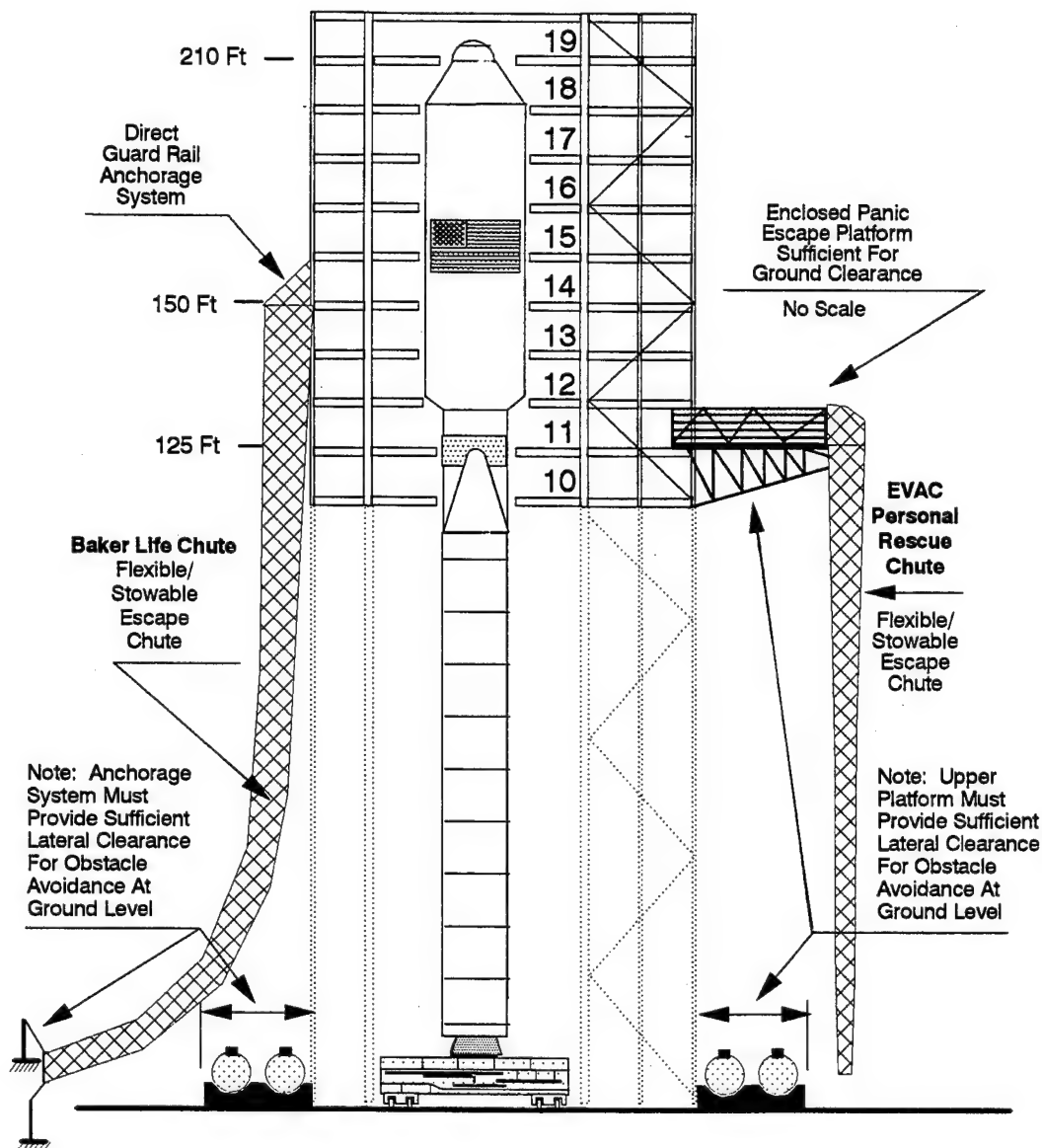
b. Escaping personnel must exit the clean room threat area, locate the nearest stairwell to lower elevations and descend a vertical distance that may exceed 100 feet. This must be done under emergency/panic conditions, with a limited air supply, and with the possibility of transporting casualties. Fire department rescue personnel are located at fallback locations. Emergency assistance will not be available to the clean room crew until after they reach the ground level and evacuate the launch tower area.

4. Launch Tower Escape Chute System Operational Requirement and Concept of Operations.

a. Personnel working inside CCAS and VAFB clean rooms or who may be working in the proximity of other hazardous systems/operations require a direct, rapid, emergency egress system from the launch tower elevation where the hazardous operation takes to the ground elevation, below.

b. The most economical emergency egress system consists of a mobile/portable, lightweight escape chute. This system would be deployed only during selected hazardous operations. It would be connected to the MST superstructure by means of stainless steel collar or panic escape platform, Figure F-1.

c. The escape chute would be constructed of light weight, high strength, materials, and would extend from the MST connection system to the ground below. It would be positioned to provide the required lateral clearance from the launch tower superstructure and to avoid any facilities or equipment that may be in the egress area. Anchorage at the ground-level egress point may or may not be required.



Operational Concept

Panic escape platforms or chute connection collars are attached to the MST at levels where Centaur &/or payload propellant transfer hazardous operations take place. For fire and/or explosive vapor threats, personnel would exit the clean room (or other) area and use the escape chute emergency egress system to reach ground level without assistance. Escape chutes would be deployed only during hazardous operations. They would be stored in weather-tight mobile containers at each level of installation.

Figure F-1. Launch Tower Emergency Escape Chute Configuration And Operational Concept

d. One or more escape chutes would be installed, depending on the threat level, the configuration of the clean room and launch tower superstructure, and range safety directives.

e. Escaping personnel will enter the escape chute system at the hazard elevation and exit chute at ground level without any outside assistance at either level. The crew making the emergency evacuation may assist each other at the top or ground level locations, as required. However, there will be no additional personnel standing by at either chute location to provide entry or egress assistance.

f. Each escape chute system would be protected by a separate, reflectorized outer cover to provide radiant and conductive heat protection from clean room or other fire threats. The reflectorized cover is needed only for those elevations where fire threats may occur, and need not extend the full length of the fully operational chute.

g. Upon completion of the hazardous operation or the emergency egress, the escape chute system (s) would be removed from the launch tower, cleaned and stored, and otherwise processed for re-use.

5. Launch Tower Escape Chute Performance Specifications.

a. The escape chute system shall be of sufficient diameter throughout its length to accommodate persons attired in NASA-developed Self-Contained Atmospheric Protective Ensembles (SCAPE). The minimum required diameter of the upper anchor ring for entry into the escape chute tube at top of the system shall be TBD feet. Commercially available systems have topside anchor systems in the 2 to 3-foot diameter range. Personnel in SCAPE with portable air bottles may require a larger opening. The minimum required diameter of the lower anchor ring for egress from the escape chute tube at ground level shall be TBD feet.

b. The escape chute web/fabric sections shall be constructed of high tensile strength, non-corrosive material (s) that are resistant to Atlantic and Pacific coast salt water spray, wind, temperature, UV radiation and other weather conditions. The expected maximum simultaneous evacuee loading that the chute must safely support is 10 personnel attired in SCAPE with a total weight of 2,500 pounds.

c. The reflectorized outer cover shall consist of a NFPA-compliant, heat-resistant, reflective material, such as that produced by the Gentex Corporation. Such material shall be resistant to Atlantic and Pacific coast salt water

spray, wind, temperature, UV radiation and other weather conditions, to the maximum extent possible.

d. The escape chute upper anchor system shall be capable of being secured to CCAS and VAFB launch tower superstructure steel members at various locations (See Figure F-1). The design of the upper anchor section, panic platform (if required) and connections to the outer edge of the launch tower shall provide a continuous enclosed area to safely enter the chute. The entry system design shall account for the panic evacuation of personnel in cumbersome SCAPE suits with limited visibility and dexterity.

e. The escape chute assembly must be capable of being positioned at the upper level hazard area and anchored at the ground level (if required) to provide the required lateral clearance for effective use of the chute and to avoid ground-level obstacles in the exit area.

f. The escape chute system must be capable of providing emergency egress from launch tower hazard areas without assistance from additional/other personnel who are not a part of the hazardous operation crew. Assistance shall not be provided at either the elevated chute entry level or at the ground-level chute egress point.

g. The maximum escape chute length shall be TBD feet (Approximately 200-ft). The maximum length of the reflectorized outer cover shall be TBD (Approximately 100 feet).

h. The escape chute system shall be designed for ease of installation, deployment and retraction and reuse.

i. The escape chute system shall include a wheeled, weather-tight storage container.

j. All escape chute and storage container metal components shall be manufactured of stainless steel.

k. The escape chute system shall include manufacturer's requirements for cleaning, maintenance, repair and replacement of components due to wear and tear, as well as for exposure to temperature and weather conditions. A detailed installation, deployment, retraction and maintenance manual also shall be provided.

6. Potential Commercial Sources.

Baker Safety Equipment, Inc.
Pyles Lane
New Castle, Delaware 19720
(302) 652-7080

EVAC Systems, Inc.
4200 Somerset, Suite 230
Prairie Village, Kansas 66208
(913) 648-8546

Ralph T. Baker, President

Rick Boeshaar, President

7. Estimated Cost

\$30 -\$35K per 200-ft escape chute system.

APPENDIX G

HAZARDOUS MATERIAL (HAZMAT) EMERGENCY RESPONSE PLAN for SPACE VEHICLE LAUNCH SUPPORT AND PAYLOAD PROCESSING CONTRACTORS

Notes:

1. This document is intended for adoption by support contractors at Cape Canaveral Air Station, FL, and Vandenberg Air Force Base, CA. It should be tailored to the specific facility site conditions, hazardous operations and dangerous chemicals that are applicable to each contract operation.

2. The plan is organized in accordance with OSHA 29 CFR 1910.120 (q), *Emergency response to hazardous substance releases*. It contains all of the minimum requirements for worker safety, planning, training, documentation and medical surveillance that are mandated by OSHA law.

**DRAFT HAZARDOUS MATERIALS (HAZMAT) EMERGENCY RESPONSE PLAN
FOR
SPACE VEHICLE LAUNCH SUPPORT AND PAYLOAD PROCESSING
CONTRACTORS**

1. PURPOSE

This plan details policies, procedures, responsibilities and required actions that govern the emergency response of **(Company Name)** management and employees to the actual or potential accidental release or spill of hazardous materials/chemicals (HAZMAT) on or nearby Cape Canaveral Air Station (CCAS), FL, and Vandenberg Air Force Base (VAFB), CA.

2. SCOPE

a. The title of this document is the **(Company Name)** HAZMAT Emergency Response Plan **(The Plan)**.

b. The Plan defines actions and procedures to minimize the health and safety hazards to company and government employees, other personnel on CCAS/(VAFB), and the general public during the company's response to any unplanned, sudden release (or potential release) of HAZMAT that may occur during the accomplishment of space launch vehicle mission support and payload processing operations.

3. DEFINITIONS

a. **Release** - Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, leaching, dumping, or disposing of a pollutant or potential pollutant into the environment.

b. **Incidental Release** - A small liquid spill or vapor release that can be terminated and cleaned up by properly trained and equipped **(Company Name)** employees within the spill site. The mandatory conditions for the declaration of an incidental release are:

(1) The chemical identity of the released material is known.

(2) The spill is small:

(a) A liquid chemical spill area of 100 square feet or less (approximately 10 gallons) on a flat, smooth, impervious surface. Associated vapor releases are contained within the work area and do not constitute a chemical exposure health hazard to unprotected personnel..

(b) A powdered or granular chemical spill of 10 pounds or less (covers an area of approximately 4 square feet).

(c) Gaseous chemical releases that are contained within the work area and do not constitute a chemical exposure health hazard to unprotected personnel.

(3) The HAZMAT incident does not involve a fire or explosion, and does not pollute air, water or land.

(4) CCAS/VAFB Medical or Fire Department HAZMAT Response Team or other assistance from the CCAS/VAFB disaster response force is not required.

(5) Sufficient trained and certified (**Company Name**) personnel, personal protective equipment (PPE) and Spill Response Cart inventory exist within the (**COMPANY NAME**) work area to contain and neutralize the spill or released chemical (s) and to decontaminate and clean up the spill site.

c. **HAZMAT Emergency** - any unplanned, sudden release of a chemical or hazardous waste material that is beyond the(**Company Name**) immediate response capability of the work area or pollutes the environment. Any potential release of a HAZMAT associated with a system or material failure, equipment or vehicle accident.

(1) Any HAZMAT incident that results in fire, explosion or personnel injury, or pollutes the air, water, or land.

(2) Any HAZMAT incident that results in the initiation of a 911 assistance call to CCAS/VAFB fire, medical, security and/or bioenvironmental respondents.

(3) Incidents involving actual or potential chemical exposures that present an imminent danger to unprotected personnel and/or the environment.

d. **Spill Response Carts** - Pre-positioned in each (**Company Name**) facility or location supporting CCAS/VAFB space launch vehicle support, payload processing, fuels and propellants storage, handling and transfer, fuel storage and transfer system O&M, and logistics and transportation operations support facilities involving hazardous chemicals. Contain sufficient PPE, materials, tools and equipment to support (**Company Name**) work area spill response operations to include: Material Safety Data Sheets (MSDS) for chemicals used in the work area, neutralizers, absorbent materials and spill containment devices (dikes) for spill control, neutralization, decon and cleanup operations.

4. MANDATORY FEDERAL REGULATIONS COMPLIANCE REQUIREMENTS

This Plan fulfills the explicit planning requirements of OSHA, EPA and DOT Federal Regulations for HAZMAT emergency response. In cases of overlapping requirements, the most restrictive or comprehensive provision has been adopted into the (Company Name) Plan. Applicable regulations are listed below.

a. OSHA Hazardous Waste Operations and Emergency Response, 29 CFR Part 1910.

(1) Section 1910.120 (q), Emergency Response to Hazardous Substance Releases. Applies to employers whose employees are involved in emergency response operations for releases of, or substantial releases of, hazardous substances without regard to the location of the hazard.

(2) Section 1910.120 (q)(1), Emergency Response Plan, requires compliance with Section 1910.38 (a), Employee Emergency Plans and Fire Prevention Plans - Emergency Action Plan. These sections apply to employers whose employees will evacuate from the danger area and do not assist in handling the emergency.

(3) Section 1910.1200 (e), Written Hazard Communication Program, requires plans and procedures for employees that clean up a small spill or release within the spill site where there is no potential safety or health hazard from fire, explosion or chemical exposure.

b. EPA Hazardous Waste Regulations - 40 CFR Part 262, Standards Applicable to Generators of Hazardous Waste.

(1) Section 262.34 (a)(4), Accumulation Time (90-day), requires compliance with 40 CFR Part 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, as follows:

(a) 40 CFR 265.16 - Personnel Training

(b) 40 CFR 265, Subpart C - Preparedness and Prevention (Sections 265.30-265.34)

(c) 40 CFR 265, Subpart D - Contingency Plan and Emergency Procedures (Sections 265.51-265.56)

c. EPA Designation, Reportable Quantities, and Notification Requirements for Hazardous Substances under CERCLA - 40 CFR Part 302, Designation, Reportable Quantities and Notification, Table 302.4, List of Hazardous Substances and Reportable Quantities (RQ).

d. EPA Superfund Amendments and Reauthorization Act (SARA) of 1986 - 40 CFR Part 355, Emergency Planning and Notification (Sections 355.10 - 355.50) and Appendices A & B, The List of Extremely Hazardous Substances and Their Threshold Planning Quantities.

e. DOT Hazardous Materials, Substances and Waste Regulations - 49 CFR Part 172, HAZMAT Table, Special Provisions, HAZMAT Communications Requirements, Emergency Response Information and Training Requirements.

(1) Subpart G - Emergency Response Information (Sections 172.600 - 172.604)

(2) 49 CFR 172, Subpart H - Training (Sections 172.700 - 172.704)

5. APPLICABLE AIR FORCE DIRECTIVES

a. Air Force Instruction 32-4002, Hazardous Material; Emergency Planning and Response Compliance, 9 May 1994.

b. Air Force Instruction 32-4001, Disaster Preparedness Planning And Operations, 6 May 1994.

c. Air Force Instruction 91-301, Air Force Occupational And Environmental, 19 May 1994.

d. 30th Space Wing or Det 1, 45th Space Wing, Disaster Preparedness Operations Plan, OPLAN 355-1, Volume 1, (Date).

6. APPLICABLE (COMPANY NAME) DOCUMENTS.

Relevant examples of Company policy directive topic areas (titles are estimated) to cite in this section are listed. Use current Company policy and procedures documents.

- Hazardous Materials (HAZMAT) Incident Response and Reporting.
- Transporting, Handling and Storing Hazardous Materials.
- Hazardous and Controlled Waste Management.
- Hazard Communication Program To Inform Employees of Hazards.
- Department of Labor Inspections.
- Respiratory Protection Program.
- Combustible Liquid & Oxidizer Storage.
- Hypergol Container/Transportation System & Spacecraft Component Maintenance, Cleaning and Decontamination.
- Medical Surveillance Program for Hazardous Operations Personnel and HAZMAT Emergency Responders.

7. AMENDMENT OF THE PLAN

a. This plan will be reviewed and amended, as necessary, whenever:

(1) Applicable(**Company Name**), USAF or Federal (EPA, DOT or OSHA) regulations or policies/procedures change.

(2) This plan fails in an emergency.

(3) (**Company Name**) facilities or CCAS/VAFB launch vehicle or payload system changes result in a material increase in potential for fire, explosion or HAZMAT release or require emergency response actions to change.

(4) Annually, for organizational and technical sufficiency, if none of the above apply.

b. Annexes to this plan will be revised annually to reflect changes in (**Company Name**) facilities or launch/payload systems, or when significant changes in responsible personnel or emergency response materials and equipment require an update of the data presented therein.

8. (**COMPANY NAME**) INCIDENT COMMAND SYSTEM (ICS)

a. (**Company Name**) Incident Command System - a modular organizational structure and command and control system that defines (**Company Name**) employee roles and responsibilities in HAZMAT emergency response operations, Figure G-1.

b. (**Company Name**) HAZMAT Emergency Response Team - the minimum required organization and personnel to conduct HAZMAT emergency response operations required by AFI 32-4002, as depicted in Figure G-1.

(1) The company on-site command and control element consists of a Team Commander (1 person) and Safety-Communications Officer (1 person).

(2) (**Company Name**) HAZMAT emergency response operations in actual or suspected hazardous/toxic chemical threat areas (Hot Zones) are conducted by 4-person (minimum) teams:

(a) A Site Entry Team and a Backup Site Entry Team of two personnel each.

(b) A Restup Site Entry Team of two persons may be added when multiple site entries require significant rest and recuperation between shifts.

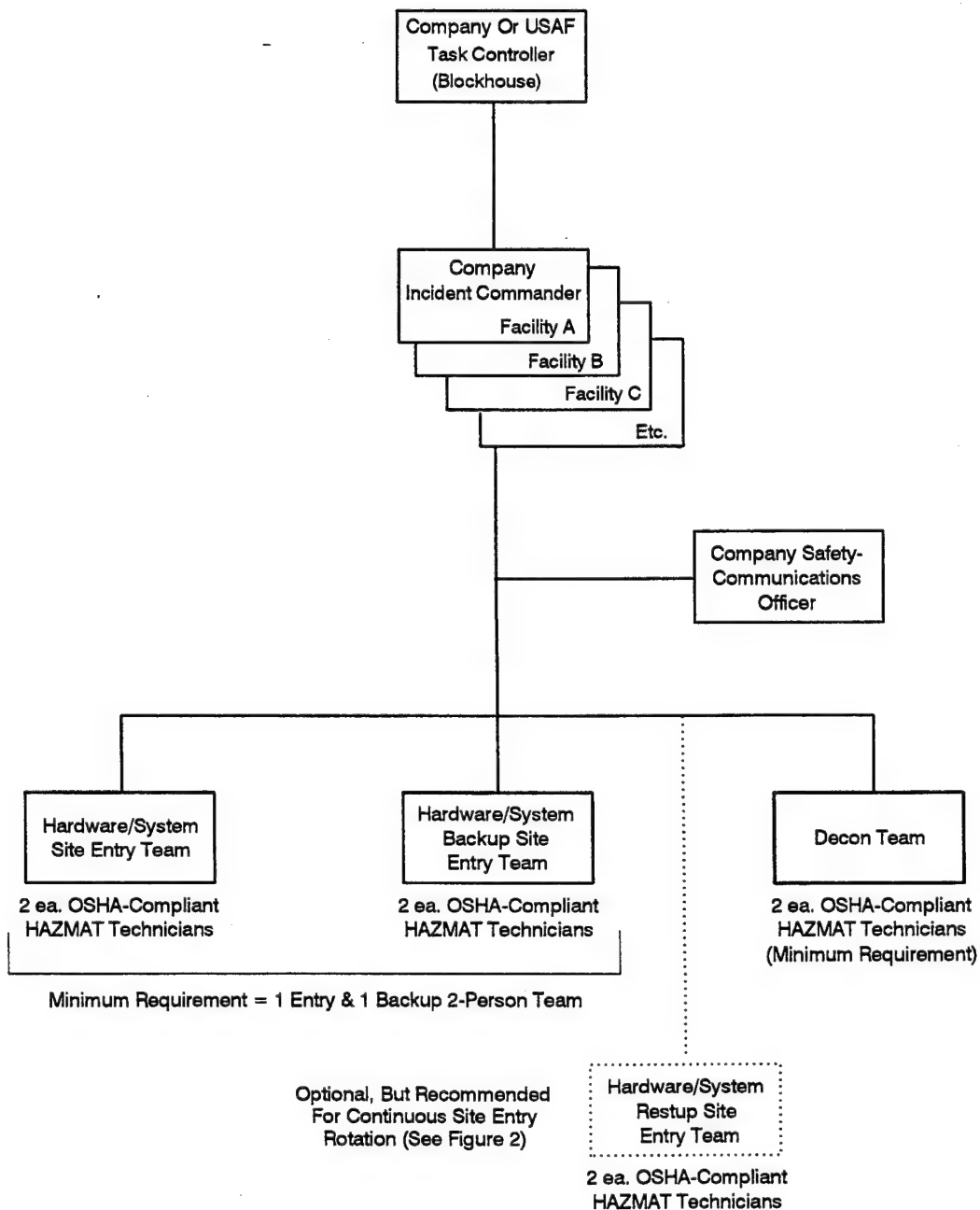


Figure G-1. **(Company Name)** HAZMAT Emergency Response Team and Incident Command System (ICS)

c. **(Company Name)** HAZMAT Emergency Response Team Commander

(1) The designated (in writing) responsible **(Company Name)** employee(s) who is(are) in charge of **(Company Name)** HAZMAT emergency response operations at each specific work location where accidental chemical releases may occur.

(2) Trained to 29 CFR 1910.120 (q) HAZMAT Incident Commander requirements.

(3) Responsible for the health and safety of all (Company Name) Team members during HAZMAT emergency response operations and for the proper selection and use of required personal protective equipment.

(4) Coordinates and directs all (Company Name) resources in response to CCAS/VAFB/USAF HAZMAT Incident Commander (Senior Fire Officer) or CCAS/VAFB Disaster Response Force Commander (Base Commander) requirements.

(5) Serves as CCAS/VAFB HAZMAT Incident Commander at the company workplace chemical release incident site until relieved by CCAS/VAFB Fire Department Senior Fire Officer (SFO), CCAS/VAFB/USAF HAZMAT Team Incident Commander, or CCAS/VAFB Disaster Response Force Commander (Base Commander).

d. (Company Name) Safety-Communications Officer

(1) (Company Name) safety individual on site during HAZMAT emergency response operations.

(2) Trained to 29 CFR 1910.120 (q) HAZMAT technician requirements.

(3) Assists Incident Commanders and identifies and evaluates hazards at the spill/release site.

(4) Directs (Company Name) incident response termination and release area evacuation, if Immediately Dangerous To Life Or Health (IDLH) conditions are identified at the incident site. IDLH conditions are defined as:

(a) An atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life, or would cause irreversible or delayed health effects, or would interfere with an individual's ability to escape from a dangerous atmosphere that are identified by air monitoring, visual, or other detection means and that would affect **unprotected personnel**.

(b) The imminent danger of fire or detonation of explosive vapor concentrations, ignition of solid rocket motor propellant or the detonation of ordnance associated with launch vehicles, payloads or support facilities and vehicles.

e. (Company Name) Site Entry Teams

(1) Site Entry Teams

(a) Provide HAZMAT emergency response specialized technical support to the CCAS/VAFB fire department's HAZMAT Response Team or DRF IAW AFI 32-4002, OPLAN 355-1 and other company and/or USAF applicable hazardous operations emergency procedures documents.

(b) Trained to 29 CFR 1910.120 (q) HAZMAT technician requirements.

(c) Perform specific hardware tasks to prevent, control and stop the release of hazardous chemicals caused by mechanical malfunctions or material failures. Systems or facilities requiring such technical support capability include, but are not limited to: payloads and launch vehicle propellant storage tanks/transfer systems, bulk hypergol transfer systems and components, hypergol storage systems and containers, launch vehicle and payload support equipment and/or specialized facility systems supporting launch vehicle or payload processing operations.

(d) Other duties that also may be directed by the CCAS/VAFB HAZMAT Response Team Incident Commander or DRF commander include:

- Assistance in the containment and neutralization of the HAZMAT.
- Site cleanup.

(2) Backup & Restup Site Entry Teams

(a) Standby Site Entry Team personnel for emergency assistance or rescue of the Site Entry Team inside the hot zone.

(b) Trained to 29 CFR 1910.120 (q) HAZMAT technician requirements.

(c) May assist in site cleanup, if directed by the CCAS/VAFB HAZMAT Incident Commander.

(3) 3-Team Approach

Ensures adequate rest and cool-down of entry teams donned in SCAPE or Level A PPE before next re-entry, Figure G-2. The 1st entry team goes to restup; the 1st backup team goes to entry, and 1st the restup team goes to backup.

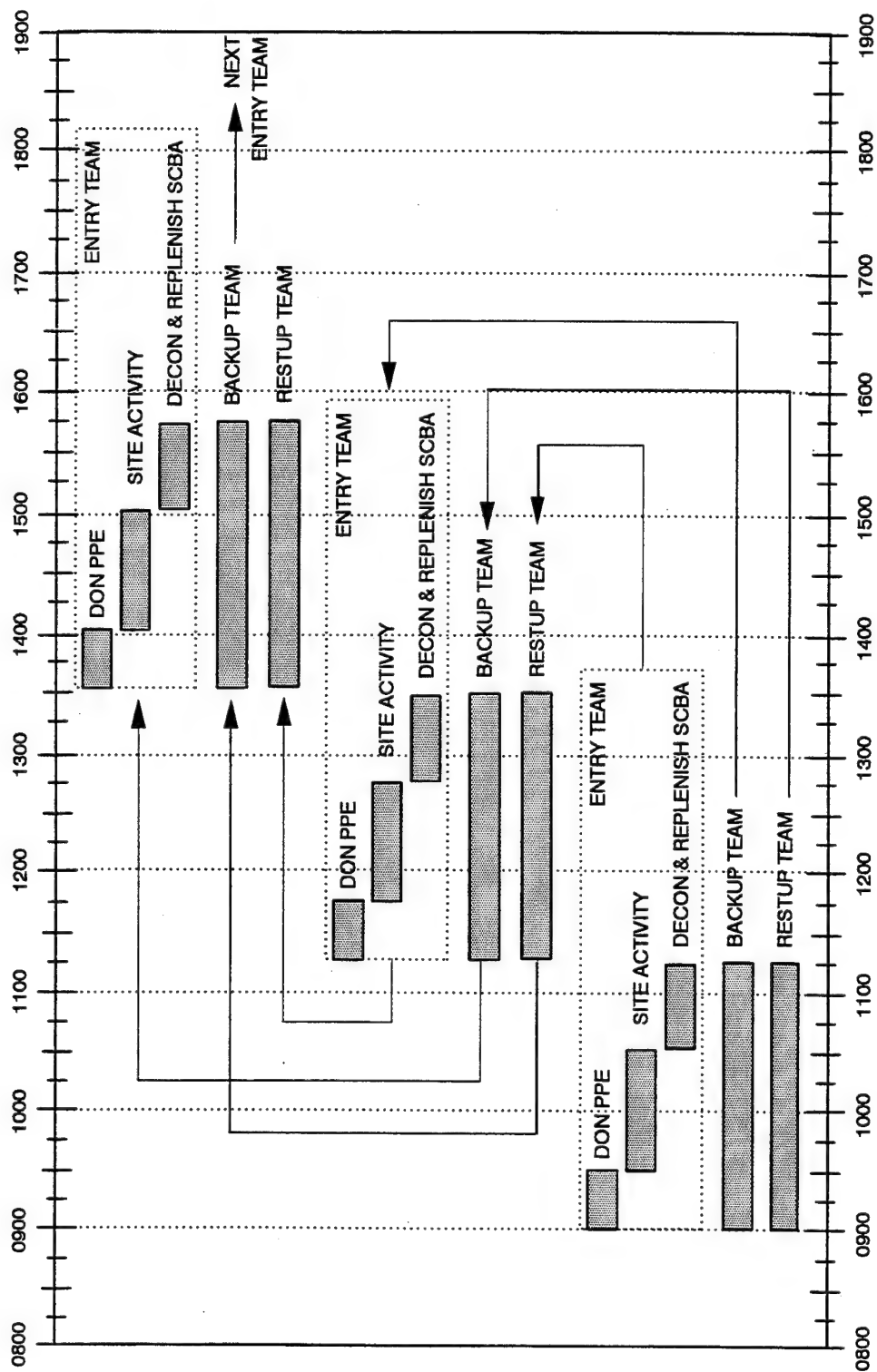


Figure G-2. (Company Name) 3-Team Site Entry Rotation Schedule

9. CCAS/VAFB INCIDENT COMMAND SYSTEM (ICS)

a. The CCAS/VAFB ICS is the modular organizational structure and command and control system that defines CCAS/VAFB Disaster Response Force (DRF) component roles and responsibilities in HAZMAT emergency response operations on or nearby CCAS/VAFB. Det 1, 45 SPW OPLAN 355-1, Disaster Preparedness Operations Plan, defines the CCAS/VAFB ICS structure, which shall be used for all HAZMAT emergency response operations. Figure G-3 shows this ICS adopted for joint military-contractor emergency actions.

b. The DRF on-scene commander is the HAZMAT emergency response incident commander. This will, normally, be the CCAS/VAFB Base Commander, the CCAS/VAFB Deputy Base Commander, the CCAS/VAFB Fire Chief or the Senior Fire Officer on the scene.

c. As a minimum, the DRF on-scene commanders will be trained to 29 CFR 1910.120 (q) HAZMAT Incident Commander requirements.

d. DRF commanders and fire department personnel are not trained and experienced to assess the system-level safety and technical issues associated with HAZMAT release involving space launch and payload processing systems, equipment and facilities. Therefore, Det 1, 45 SPW OPLAN 355-1 and the CCAS/VAFB HAZMAT Emergency Response Plan require CCAS/VAFB prime contractors to provide emergency response teams who are available, if needed, to assist the CCAS/VAFB HAZMAT Response Team in incident response and cleanup activities. This requirement applies to all contractor organizations that provide personnel in support of hazardous operations or who may operate or maintain systems or equipment that can be involved in HAZMAT release/spill incidents.

e. In compliance, **(Company Name)** will provide the **(Company Name)** HAZMAT Emergency Response Team, as defined in Paragraph 8, above.

f. The CCAS/VAFB DRF Incident Command System with civilian contractor subordinate HAZMAT emergency response teams is depicted in Figure G-3. Company HAZMAT Emergency Response Teams must consist, as a minimum, of a Company Incident Commander, Safety-Communications Officer and HAZMAT Entry Teams (2-person hot zone entry teams, with 2-person backup team) at every CCAS/VAFB facility location where company employees may be participants in HAZMAT emergency response operations. The **(Company Name)** ICS is attached at a subordinate level to the Fire Department, and responds to the direction of the DRF Commander, through the HAZMAT Team leader during HAZMAT emergency response operations.

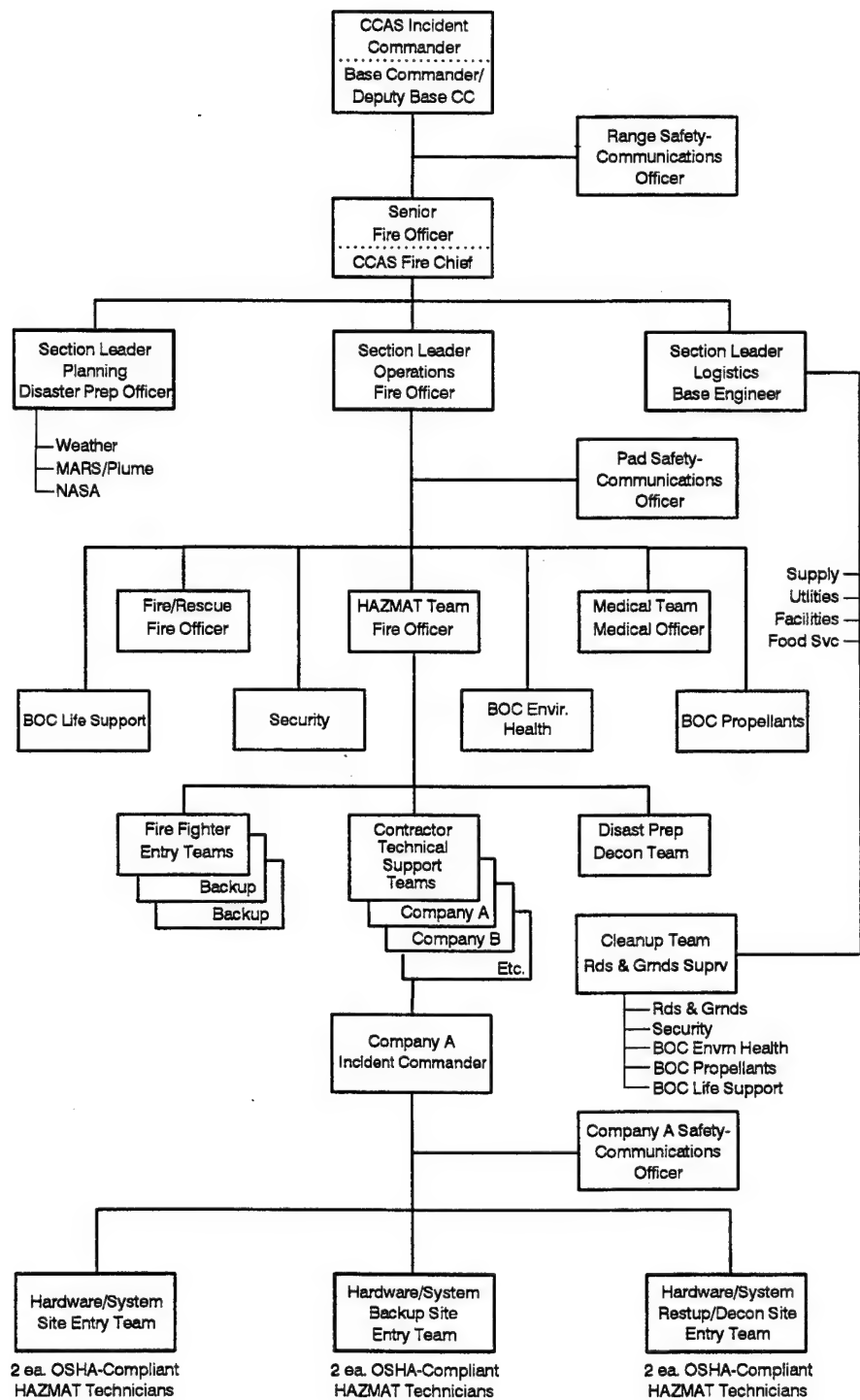


Figure G-3. CCAS/VAFB OSHA-Compliant Incident Command System

10. CCAS/VAFB HAZMAT RELEASE INCIDENT CONCEPT OF OPERATIONS

a. The CCAS/VAFB HAZMAT Emergency Response Concept Of Operations (CONOPS) defines the basic actions and interactions of the CCAS/VAFB DRF during a response to an accidental HAZMAT release on CCAS/VAFB. It is intended to depict the time-phased assumption of command and control for both **(Company Name)** personnel and the other military and support contractor (Fire Department) elements of the DRF, and the mechanics for directing incident response forces.

b. The purpose of this CONOPS is to define a realistic set of emergency conditions that would require the employment of **(Company Name)** personnel in support of the CCAS/VAFB HAZMAT Response Team. The CONOPS is organized on a timeline basis, and is built upon a foundation of reasonably correct command and control decisions being made by both **(Company Name)** and DRF incident commanders.

c. HAZMAT incident command and control responsibilities and interrelationships with the site/complex/facility Officer-In-Charge (OIC), Non-Commissioned Officer-In-Charge (NCOIC) and the DRF immediately following the discovery of a hypergolic/HAZMAT chemical release are detailed in the following subparagraphs.

(1) Definition of HAZMAT Emergency Response Activities

OSHA 29 CFR 1910.120 (q) standards for HAZMAT emergency response apply to **all** USAF and civilian contractor **employers** whose employees (USAF military & civil servant or contractor) participate in the emergency response to hazardous chemical releases. Emergency response actions include:

(a) Entry into the chemical release area (hot zone) to identify and terminate the leak/release situation, rescue personnel, or to combat fires, including backup forces;

(b) Direction, command and control of any personnel taking part in the HAZMAT emergency response;

(c) Assessment of incident site safety conditions, monitoring of hazards and determination of response personnel personal protective equipment requirements;

(d) Participation of site and personnel decontamination and cleanup resulting from the incident and/or incident response operations.

(e) As a general rule, any person who does not immediately evacuate the incident area, and who may be a potential or actual contributor to the HAZMAT release/cleanup effort, must be trained and protected to the OSHA standard for HAZMAT emergency response.

(2) The Initial HAZMAT Release Discovery Situation

(a) As specified in our contract deliverable requirements, **(Company Name)** employees are participants and/or are present on-site, during hazardous operations involving HAZMAT chemicals (hypergolic and cryogenic propellants, solid propellants, ordnance, and other toxic chemicals) at CCAS/VAFB facilities.

(b) Initial Emergency Immediate Response Actions (Any Employee)

1 Discoverer sounds verbal alarm in immediate area.

2 If imminent danger (fire, explosion, hazardous chemical exposure or personnel injury), the discoverer:

- Activates area alarms & emergency systems.
- Assists injured personnel, if possible.
- Evacuates facility via safe route.
- Notifies 911.
- Proceeds to marshaling area and reports to company incident commander or Complex/facility OIC/NCOIC.
- Advises Company or USAF incident commander on specifics at emergency incident site upon his/her arrival.
- Remains with company incident commander. Briefs CCAS/VAFB incident commander (senior fire officer) upon his/her arrival at the incident site area.

(3) First Response By Fully-Protected Personnel

(a) Company personnel who are fully protected against toxic chemical vapor and liquid contact threats, i.e. donned in OSHA Level A protective ensembles or SCAPE may remain in a incident area to deal with the release/leak situation, only if the following conditions are met:

- Personnel are trained to the OSHA Technician Level
- No explosive or fire threat exists.
- Full OSHA Level A protection is worn and sufficient breathing air is available.
- All activities are monitored by the company/USAF command and control structure (blockhouse).

(b) Actual emergency response operations may not be started in the hazard area until the **(Company Name)** HAZMAT Emergency Response Team Incident Commander and Communications-Safety Officer are at the designated command and control location, are in communication with the personnel at the release site, and have formally taken charge of the operation.

(c) All release site actions to identify, isolate and/or terminate a release situation must be in accordance with the written company/USAF emergency procedures annex for the hazardous operation task that generated the incident/situation.

(d) If extraordinary measures are required that are not covered by written Company or Air Force procedures, such actions will not be taken until authorized by the DRF Incident Commander, following consultations with senior systems engineering, Range Safety, Pad Safety personnel and other appropriate personnel.

(4) The Responsible Company On-Scene Task Supervisor

(a) When an accidental release occurs, the **(Company Name)** supervisor of the task that generated or initiated the emergency condition is responsible to take the emergency actions required for the safe evacuation of personnel, the 911 notification that a HAZMAT release incident has occurred, and the activation of emergency systems.

(b) *Unless trained as an OSHA Incident Commander, the task supervisor does not direct employees to identify, mitigate, control or terminate the accidental release.*

(c) Upon the arrival of the designated Company HAZMAT Emergency Response Team Commander or the Complex/Facility military OIC/NCIOC Incident Commander, or the DRF Incident Commander at the incident site, command and control of Company employees is passed from the initial

responsible supervisor to the trained Incident Commander. The responsible supervisor briefs the arriving Incident Commander on all known incident factors and remains available for further clarifications and consultations until dismissed.

(5) The **(Company Name)** HAZMAT Emergency Response Team Incident Commander

(a) The **(Company Name)** HAZMAT Emergency Response Team Incident Commander seeks out the On-Scene Task Supervisor and formally assumes the responsibility as the initial incident commander. He/she is responsible, by **OSHA Law**, for the safety and welfare of company employees for the duration of the incident. The Company Incident Commander is in charge of all emergency response actions by **all personnel** (company, military, civil servant & other contractors) until the arrival of the site/complex/facility Officer In Charge (OIC) or Non-Commissioned Officer In Charge (NCOIC), the DRF senior fire officer, or the DRF Incident Commander.

1 The company incident commander coordinates **all** emergency actions with his/her Safety-Communications Officer, as well as pad and/or range safety, as he/she authorizes and directs the on-scene emergency response actions of company employees.

2 Initial emergency response actions include sounding of alarms, notification of 911, rescue of injured personnel, the identification of safe evacuation routes, directing/assisting the evacuation, and activation of emergency fire and exhaust systems.

(b) If the Complex (Facility) OIC/NCOIC are not available to assume command, the **(Company Name)** task supervisor/incident commander remains in charge of the emergency operation until relieved by the Disaster Response Force on-scene commander (usually, the senior fire officer, the CCAS/VAFB Base Commander or the CCAS/VAFB Deputy Base Commander).

(6) The Complex (Facility) OIC/NCOIC /Incident Commander

The site OIC/NCOIC seeks out the responsible **(Company Name)** task supervisor and assumes incident command at the earliest possibility consistent with safe and orderly evacuation from the release site. The OIC/NCOIC establishes initial entry control points and marshaling area personnel accountability actions. He/she is the on-scene interim DRF incident commander at the site until the arrival of the senior fire officer (fire chief or operations assistant chief) or the CCAS/VAFB Base Commander/Deputy Base Commander, who assumes command of the situation.

(7) The CCAS/VAFB DRF On-Scene Incident Commander

(a) The DRF commander is responsible for the command and control of all personnel, vehicles and equipment on site that support the required emergency response operation (s).

(b) The DRF commander assumes command from the most senior incident site official - the company incident commander or the complex OIC/NCOIC. The DRF commander is briefed on all site hardware and chemical/fire hazard conditions, personnel status, and suggested incident response activities by the supervisors who witnessed or participated in the task that led to the release, and those who supervised the initial emergency response (evacuation, rescue, emergency systems, etc.).

(c) The DRF Commander may transfer command and control to a subordinate incident commander, once initial rescue, fire fighting and/or release termination activities are complete. In general, the senior fire officer will remain on-site as the incident commander, until all decontamination and clean up activities are complete.

(8) Immediate Rescue of Injured Company/Other Employees In SCAPE

(a) The rescue and initial decontamination of **(Company Name)** or other employees in SCAPE that are injured in an area of high toxic chemical contamination must be conducted by the **(Company Name)** or other SCAPE backup crew. The CCAS/VAFB fire department will be at a fallback position during HAZOPS, and will not be attired in a fully-encapsulated ensemble. It will take from 15 to 30 minutes for them to fully dress out in their HAZMAT emergency response Level A (fully encapsulated protective suit & SCBA) personal protective equipment and gain entry into the hot zone where the injured are located, once they have been notified of the incident.

(b) The injured company employee must be immediately assisted by the company backup SCAPE team and/or any uninjured SCAPE personnel in the HAZOPS area. Casualties must be removed from the contaminated area and transported to a location where decontamination and transfer to the fire-rescue squad can take place.

(c) Detailed procedures and equipment are required to ensure the casualty's breathing air is sufficient to enable removal from the hazard area and decon, before removal from the SCAPE ensemble is initiated. Injured SCAPE personnel on tethered air will require transfer to a portable bottle. Other uninjured personnel may also be on tethered systems, and will have to carry their own air supply bottles

during evacuation from the accident site. This situation requires backup team members to be in backpack air supply ensembles to effect the rescue and extraction of an injured employee. Multiple injuries will exponentially compound this rescue equation in a toxic vapor environment.

11. PRE-EMERGENCY PLANNING AND COORDINATION WITH OUTSIDE PARTIES

a. The **(Company Name)** Emergency Preparedness Coordinator will submit the **(Company Name)** Hazardous Materials Emergency Response Plan to the CCAS/VAFB Disaster Preparedness Officer for coordination and approval upon its initial submittal, and following revisions that change either policy, responsibilities or emergency response procedures.

b. Following USAF approval of the Plan or amended Plan, copies will be distributed to:

(1) CCAS/VAFB Fire Departments and Security Police (LBS on CCAS).

(2) CCAS/VAFB Emergency Medical Services and Environmental Health (BOC on CCAS).

(3) NASA KSC Disaster Preparedness Office and Fire Chief (BOC/CCAS Only).

(4) The emergency preparedness coordinators of other contractors who may participate or interface with **(Company Name)** HAZMAT emergency response operations.

(5) Other offices/organizations, as directed by the USAF.

c. The **(Company Name)** Emergency Preparedness Coordinator will represent the company at all USAF and NASA KSC meetings, committees, teams or similar functions regarding HAZMAT emergency planning and coordination and/or HAZMAT incident emergency response.

d. **(Company Name)** HAZMAT Emergency Response teams will participate in USAF-directed HAZMAT incident response drills and exercises to determine Plan effectiveness and **(Company Name)** employees' emergency response readiness and proficiency. Such exercises may include response by surrounding community, State of Florida or Federal HAZMAT emergency response teams or representatives.

e. Formal, direct planning and coordination with County and State agencies dealing with HAZMAT incident emergency response planning and operations will be conducted by the **(Company Name)** Emergency Preparedness Coordinator only following approval from the USAF.

f. A copy of this plan will be provided to the Administrators of the **(Names of military and local area hospitals)** to familiarize them with the properties of hazardous materials handled by **(Company Name)** employees and the types of exposures, injuries and illnesses that could result from a HAZMAT incident. This planning action is taken because of the possibility that these hospitals may provide treatment to **(Company Name)** employees who are injured in or respond to a CCAS/VAFB HAZMAT incident.

12. PERSONNEL ROLES, LINES OF AUTHORITY AND COMMUNICATION

a. Personnel Roles

(1) The **(Company Name)** Director, Support/Processing Operations (Equivalent Company Line Manager (s) Responsible For Employees Who Conduct Hazardous Operations or Provide Systems & Facilities Support, And Who , By Virtue Of Their Job Description, May Be Involved In A HAZMAT Emergency Response), shall:

(a) Designate **(Company Name)** HAZMAT Emergency Response Team Commanders in each CCAS/VAFB launch complex, payload processing facility or fuel/hypergol storage area where company employees may be involved in the response to a HAZMAT spill/release incident.

(List Facility Nomenclature & Facility Number)

(b) Ensure that sufficient **(Company Name)** HAZMAT Emergency Response Team Commanders are designated and trained to maintain coverage in each facility above during each duty shift, given such employee availability factors as annual/sick leave, holidays, other absences and extended launch schedules.

(c) Ensure **(Company Name)** HAZMAT Emergency Response Team Commanders are trained to the requirements of this Plan.

(d) Ensure that sufficient Personal Protective Equipment (PPE) are maintained at designated **(Company Name)** facilities and/or work areas for all company personnel trained for HAZMAT incidental and emergency response operations.

(e) Requisition all initial inventory items for Spill Response Carts at all designated facilities, above, and will ensure all materials, tools and PPE stored in these carts are maintained in serviceable condition.

(2) The **(Company Name)** Director, Logistics, shall:

(a) Designate **(Company Name)** HAZMAT Emergency Response Team Commanders, Hardware Teams and Backup Teams for Company logistics facilities and transportation operations.

(b) Ensure that sufficient personnel are designated and trained, to maintain complete HAZMAT incidental and emergency spill response capabilities in each transportation or logistics facility during each duty shift, given such employee availability factors as annual/sick leave, holidays, other absences or extended launch operations.

(c) Ensure logistics employees conducting HAZMAT incidental and emergency spill response operations are trained to the requirements of this Plan.

(d) Ensure that sufficient Personal Protective Equipment (PPE) are maintained in his/her **(COMPANY NAME)** facilities and/or work areas for HAZMAT incidental and emergency response operations.

(e) Requisition all initial inventory items for Spill Response Carts in facilities under his/her control, and will ensure all materials, tools and PPE stored in these carts are maintained in serviceable condition.

(3) The Director, **(Company Name)** Safety, shall:

(a) Develop and coordinate the **(Company Name)** HAZMAT Emergency Response Plan (Document Numerical Designation).

(b) Designate the **(Company Name)** Emergency Preparedness Coordinator as the OPR for the Company HAZMAT Emergency Response Plan.

(c) Establish training requirements for **(Company Name)** employees involved in HAZMAT incident emergency response.

(d) Designate work area HAZMAT incident Safety-Communications Officers to monitor incidental spill response operations in **(COMPANY NAME)** processing and logistics facilities.

(e) Sufficient Safety Officers will be designated and trained for both incidental and emergency response coverage during each duty shift, given such employee availability factors as annual/sick leave, holidays, other absences or extended launch schedules.

Note: Because of the current Launch Base Support (LBS) contractor requirement to provide Pad Safety personnel for all/most hazardous operations, Company safety personnel may not be sufficient in numbers to enable the designation of an incumbent company safety professional for each Safety-Communications Officer required under this Plan. In such a case, it is suggested that the companies involved work within the manpower constraints of their respective contracts, and consider forming composite HAZMAT Emergency Response Teams. The Incident Commander and all entry team members would be from Company A, while the Safety-Communications Officer would be provided by LBS. The only statutory requirement is that all team members are fully trained, according to their specific level of emergency response responsibility as specified by OSHA 29 CFR 1910.120(q). Such arrangements must be coordinated and approved by the Commander, Det 1, 45th Space Wing.

(4) (Company Name) supervisors in work areas where **incidental spills** occur will conduct "mop & sop" spill response actions IAW company training and procedures to include:

- (a) Stopping the release.
- (b) Containing the spilled material (s).
- (c) Neutralizing the spilled materials and absorbing the resulting material.
- (d) Depositing all resulting waste material in an approved drum and disposal IAW (Cite Applicable Company Policy Document).
- (e) Conducting incidental spill area and cleanup.
- (f) Decontaminating and reservicing PPE and equipment.
- (g) Initiating documentation to replenish expended supplies and materials from Spill Response Carts, and completing spill documentation required by (Cite Applicable Company Policy Document).

Supervisors shall ensure that all personnel involved in incidental spill mop and sop activities are fully protected against the vapor and/or splash contact threats of the chemicals involved. The mop and sop of incidental releases of hypergols by HAZOPS personnel already in SCAPE is included in this authorization.

(5) **(Company Name)** supervisors in work areas where accidental releases occur will conduct spill response emergency actions IAW company training and procedures to include:

- (a) Sounding alarms.
- (b) Notifying 911.
- (c) Activating emergency systems.
- (d) Assisting casualties.
- (e) Ensuring the safe evacuation of all personnel.
- (f) Liaison with the Company HAZMAT Emergency Response Team Commander to provide specifics of incident site conditions and system status.

(6) **(Company Name)** HAZMAT Emergency Response Team Commanders shall conduct emergency response actions IAW this Plan to include:

- (a) Hardware Team safing of propellant transfer systems or containers/vehicles, facility systems or GSE, and containment and neutralization of the HAZMAT release.
- (b) Decontamination and cleanup of the spill area by Hardware Teams, if such assistance is requested by the CCAS/VAFB Fire Department HAZMAT Response Team Commander.
- (c) Other emergency response as directed by the CCAS/VAFB Fire Department HAZMAT Emergency Response Team Commander.

(7) **Annex 1** provides a directory of **(Company Name)** personnel responsible for HAZMAT emergency response planning, policy, procedures and execution. It lists responsible company officers, including the Emergency Preparedness Coordinator, HAZMAT Emergency Response Team Commanders and Safety-Communications Officers. **(Company Name)** employees who require additional or clarifying information on hazardous materials issues or emergency response should contact the applicable person, according to this Annex.

b. Lines Of Authority

(1) All **(Company Name)** HAZMAT emergency response actions are conducted under the cognizance of the Air Force Test Director (or appropriate title), according to applicable Emergency Procedures Documents and OPLAN 355-1, and (List other applicable documents). They are executed under the

CCAS/VAFB Disaster Response Force Incident Command System (ICS), as defined in this Plan, the CCAS/VAFB HAZMAT Emergency Response Plan, and OPLAN 355-1.

(2) During the initial stage of a HAZMAT emergency (usually, the first 4-10 minutes), the **(Company Name)** HAZMAT Emergency Response Team Commander is the Interim CCAS/VAFB HAZMAT Incident Commander until relieved by the first responding more senior, OSHA-trained incident commander:

- The Complex/Facility OIC/NCOIC.
- The CCAS/VAFB Fire Department HAZMAT Response Team Incident Commander (usually the Senior Fire Officer).
- The CCAS/VAFB DRF Commander (Base Commander, Deputy Base Commander or Fire Chief)

During this time, his/her responsibilities will, generally, include taking charge of alarms, notifications, initial emergency actions, assistance with the injured, facility evacuation and personnel accountability, as defined later in this plan.

(3) **(Company Name)** HAZMAT Emergency Response Team Commanders have full authority for and over the company personnel, materials, and equipment necessary to accomplish safe and effective HAZMAT emergency response operations, according to this Plan. Should additional assets be required during an emergency response operation that are beyond the Incident Commander's immediate resources, appropriate **(Company Name)** Directors will respond to these needs on an urgent basis.

c. Communications

(Define) radio net will be used by **(Company Name)** Emergency Response Team Commanders for radio communications between the incident site and the DRF. The DRF will formally request support functions that may be required (safety, security, logistics, environmental health, transportation, heavy equipment, etc.). (Define) radio net will be the backup.

13. EMERGENCY RECOGNITION AND PREVENTION

a. CCAS/VAFB Hazardous Materials Threats Life Cycle

(1) Figure G-4 depicts the flow of a "typical" hazardous materials commodity from its receipt and storage at CCAS/VAFB Fuel storage Area #1, to its transfer and/or use during a payload or launch vehicle mission or ground support task, to the final disposition of any residue as hazardous waste. Similar flow charts identify HAZMAT storage, handling and transportation at VAFB. Generalized threats that could

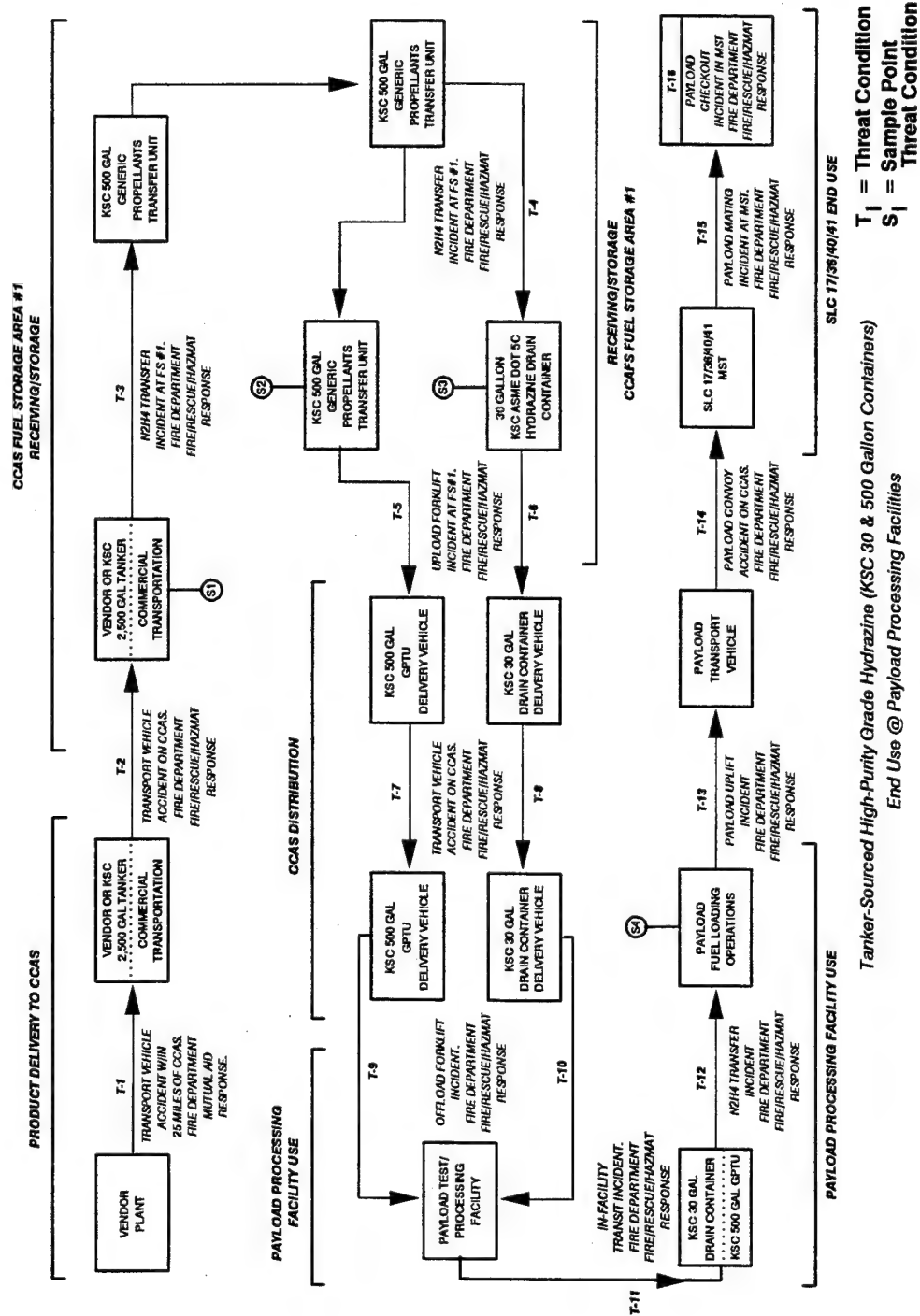


Figure G-4. CCAS HAZMAT Threat Flow Chart Example

cause the accidental release or spill of HAZMAT are also identified.

(2) There are hundreds of hazardous materials inventoried by support contractors on CCAS/VAFB that are used during thousands of payload and Atlas, Delta or Titan launch processing operations. Possible interactions between the chemicals and the mission support processes that may result in a HAZMAT release incident must be determined. The accurate assessment of all potential hazard situations is both essential and mandatory, as specified by OSHA 29 CFR 1910.119, Process Safety Management of Highly Hazardous Chemicals, Section (e), Process Hazard Analysis.

(3) In general, the combination of CCAS/VAFB chemicals and mission support tasks/operations results in a working environment that can be characterized by numerous and varied hazards which:

- May pose an immediate danger to life or health.
- May not be immediately obvious or identifiable.
- May vary according to the task location, nature and progress point and/or changing weather conditions, or as work site activities progress.
- May combine with other unrelated operations or incidents to create a more severe or catastrophic series of events.

b. Hazard Recognition

(1) All **(Company Name)** employees will attend Training Course(Specify) (1-Time), Hazard Communication, and (Specify) (Annual), Site/Area-Specific Hazardous Chemical Safety Training. (Compliance with OSHA 29 CFR 1910.1200, Hazard Communication).

(2) All **(Company Name)** Logistics personnel associated with the receipt, movement, handling or storage of hazardous materials will attend Training Course (Specify) (Every 24 months), Hazardous Materials Transportation Awareness. (Compliance with DOT 49 CFR Part 172).

(3) (Specify) Emergency Procedures Document, (Title: Hazardous Materials (HAZMAT) Incident Emergency Support or similar) identifies **(Company Name)** facility-specific processing and other support tasks with the potential for HAZMAT accidental spill/release. **(Company Name)** supervisors will identify those work-related tasks in (Specify Document) that are applicable to subordinates under their direction and control. This will be accomplished as a part of the annual OSHA Hazard Communication refresher training requirement, Para (1), above.

(4) Logistics Facility supervisors will brief subordinates annually during annual OSHA Hazard Communication refresher training on potential spill or release incident scenarios associated with HAZMAT transportation, storage and handling.

(5) The (Company Name) Emergency Preparedness Coordinator will review and coordinate on all facility Fire Protection Surveys and Pre-Fire Plans prepared by the CCAS/VAFB fire department for (Company Name) facilities requiring Company HAZMAT Emergency Response Teams. He/she will provide appropriate copies to each (Company Name) HAZMAT Emergency Response Team Commander. These documents will be used by Company incident commanders to familiarize themselves with fire department emergency procedures and the specific fire and HAZMAT threat locations in each facility where company employees could be involved in HAZMAT emergency response.

(a) Facility Surveys and Pre-Fire Plans are obtained from the LBS Fire Prevention Office. Surveys identify HAZMAT-related fire and explosion threats, fire protection detection and suppression systems, vapor removal/ventilation systems, emergency escape routes and other Life Safety Code compliance items. Pre-fire Plans identify fire department emergency response actions to be taken at each specific facility.

(b) (Company Name) Emergency Response Team Commanders will ensure that applicable HAZMAT emergency response-related data from these documents will be included in annual (Specify) hazard communication training and On-the-Job Training (OJT) associated with HAZMAT emergency response.

c. Air Monitoring

(1) Air monitoring is conducted at HAZMAT spill or release sites to identify immediate danger to life and health (IDLH) conditions, such as highly toxic levels of chemical vapors, flammable or explosive atmospheres and oxygen-deficient environments.

(2) The (Company Name) HAZMAT Emergency Response Team Commander is responsible for conducting air monitoring at the incident response site. Normally, air monitoring measurements will be directed by the Safety-Communications Officer to:

(a) Identify HAZMAT spill or release area vapor contamination levels and life-threatening conditions.

(b) Enable specification of required PPE for evacuation and incident response.

(c) Verify neutralization, decontamination and cleanup activities have eliminated threat conditions to the required safe level.

(3) (Company Name) HAZMAT Response Team Commanders will request air monitoring from the DRF Incident Commander (BOC Environmental Health) at any time release site conditions require such action.

(4) Explosive concentrations of hydrogen or hydrazine (AH, MMH, UDMH & A-50) vapors are identified by vapor detectors/monitors in such areas as the clean rooms or launch tower levels where possible release could occur.

(5) Portable Draeger (Direct-Reading Colorimetric Indicator Tube) are used to identify the presence of hypergolic fuel and other toxic vapors prior to and during processing and operations, as defined in applicable task instructions/procedures (Specify) and Emergency Procedures document (Specify).

(6) Direct-reading combustible vapor monitoring instruments are used to identify leak/spill sources and dangerous levels of vapor concentrations. These are located in the following (Company Name) facility work areas: (Specify).

d. Hazmat Spill/Release Incident Prevention

(1) (Specify) (Company Name) Documents, Procedures, or Instructions define policy, practice and responsibilities for the safe handling and storage of hazardous chemicals and hazardous waste materials associated with employee operations at CCAS/VAFB: (List documents).

(2) Procedures for the safe transfer/use of hazardous chemicals are defined in (Specify) (Company Name) Documents/Procedures/Instructions that direct employee actions for hazardous operations. Emergency instructions in response to potential (most likely) hardware malfunctions or material failures that may result in hazardous chemical releases are defined in annexes to each applicable task instruction (Specify document).

(3) Generalized rules to minimize HAZMAT spill/release and employee exposure potential prior to or during hazardous operations are summarized as follows. Supervisors shall ensure that:

(a) HAZMAT containers and transport vehicles/tanks and/or trailers are properly labeled and/or tagged to identify potential threat materials.

(b) HAZMAT and HAZMAT waste containers are stored in properly marked, secure, and dispersed areas that are separated from potential ignition sources by appropriate stand-off distances. Weather protective containers/storage lockers or inside storage are provided, as needed.

(c) Highly toxic propellants (nitrogen tetroxide, AH, MMH, UDMH & A-50) are stored at the CCAS/VAFB Fuel Storage Area #1, and are transported to payload processing facilities and/or launch complexes, according to payload/launch schedule mission task requirements.

(d) Corrosive, flammable, explosive and/or poisonous materials are not stored or transported in proximity to each other.

(e) Hazardous operations and supporting tasks are accomplished only by properly supervised (Company Name) personnel certified for that task, using specified, approved tools, equipment and PPE.

(f) (Company Name) Safety personnel (or LBS Pad Safety) monitor all tasks involving hazardous materials, and may be assisted by BOC Environmental Health personnel and equipment, as required by the applicable Task or Safety Directive, such as (Specify).

(g) All hazardous operations are conducted under the overall direction of the (Specify) company or Air Force operations (blockhouse) controller.

14. SAFE DISTANCES AND PLACES OF REFUGE

a. The safe distance for all employees not involved in operational first response will be the appropriate marshaling area at least (Specify) feet outside of and upwind from the building where the incident is located.

b. Personnel initially evacuated from their work stations may be directed to move to a more distant marshaling area. This action may be required by changing wind conditions and/or more specific hazard identification information determined by the emergency response force.

c. Personnel initially directed to marshaling areas, may be re-directed to specific facilities for positive protection from airborne contaminants or weather.

d. Public Address System announcements will be made to direct evacuated personnel to marshaling areas and other places of refuge, as required.

15 SITE SECURITY AND CONTROL

a. **(Company Name)** HAZMAT Emergency Response Team Commanders are responsible for initial incident site security and control until relieved by the next more senior complex/facility or DRF Incident Commander (OIC/NCOIC, senior fire officer, Base Commander, etc.).

(1) Unauthorized/ unnecessary personnel will be prevented from approaching the release area and directed to evacuate by posted escape routes.

(2) **(Company Name)** personnel may be posted to act as guards at site entry control points (roads, gates doors, hallways, stairwells, etc.) where there are no known or suspected health hazards.

(3) Under suspected IDLH conditions, site security and control will be maintained from standoff positions (Specify) feet outside and upwind from the facility in/on which the spill/release has occurred.

b. **(Company Name)** site security personnel will remain in place until the arrival of DRF security forces and the DRF ICS is established.

16. EVACUATION ROUTES AND PROCEDURES

a. Evacuation routes for **(Company Name)** facilities are contained in the applicable Emergency Procedures Document for that facility and are provided as Annex 2 to this Plan. **(Company Name)** supervisors will brief subordinate personnel on work area evacuation routes during each annual Hazard Communication refresher training period. Additionally, work area evacuation routes must be posted on each work area Safety Bulletin Board.

b. Marshaling areas for **(Company Name)** facilities with potential for HAZMAT spill/release are provided at Annex 3 to this Plan.

c. Evacuation routes will be identified to employees during each (Specify) task directive's safety/initial briefing conducted prior to hazardous operations or processing tasks or other support operations involving the handling or transportation of hazardous materials.

d. Standardized facility marshaling area locations are based on prevailing wind conditions. However, immediately following an evacuation order, the **(Company Name)** Emergency response Team Commander will request DRF to provide current wind data to confirm personnel will Marshall in an upwind location. If necessary, the **(Company Name)** Incident

Commander will re-direct evacuating personnel to an alternate marshaling area to ensure an upwind location.

e. The DRF will provide the spill's downwind hazardous vapor plume profile information to the **(Company Name)** Incident Commander and other facility managers, if required, to ensure health and safety of personnel in collateral areas of risk.

f. Evacuation procedures for HAZMAT spill/release incidents are identical to fire or bomb threat situations. Personnel will:

(1) Ensure proper notifications have been made (911, blockhouse radio net, duty officer, as appropriate) and local or area alarms have been activated.

(2) Ensure all personnel have received the order to evacuate, and assist any injured personnel in evacuation.

(3) Proceed in an orderly fashion to the nearest exit in a direction away from the spill/release site and move to the designated marshaling area outside the facility.

(4) Last person out close all exit doors.

(5) Follow Emergency Procedures Documents to remotely de-activate on-board and facility electrical and HVAC equipment, as required.

(6) Report to your supervisor immediately upon arrival at the designated marshaling area.

g. Upon evacuation of facilities to marshaling areas, **(Company Name)** Emergency Response Team Commanders will obtain head count status from supervisors. In facilities with main entry point badge accountability boards, the Incident Commander will direct board relocation to the marshaling area to cross-reference and verify final head count status.

17. HAZMAT EMERGENCY RESPONSE TRAINING

a. **(Company Name)** HAZMAT First Responder employees and HAZMAT Emergency Response Team members shall receive training based on the duties and functions they will perform following a HAZMAT release incident, Figure G-5.

Course Identifier	Course Title	(Company Name) HAZMAT Training Requirements				
		All Employees	Logistics/ Transportation Personnel	HAZMAT Site Entry Team Members	HAZMAT Emergency Response Team Commanders	Safety-Communications Officers
Course ID	OSHA Hazard Communication	●				
Course ID	OSHA Site/Area Specific Hazards Chemical Safety	●				
Course ID	OSHA HAZMAT First Responder (Awareness Level)	●				
Course ID	DOT Hazardous Materials Transportation Awareness		●			
Course ID	CCAS DRF Incident Command System (OSHA Incident Commander Level)				●	●
Course ID	OSHA HAZMAT Emergency Response Technician			●	●	
N/A	Company Managers' Verification of Hazardous System OJT & Experience			●	●	●

Figure G-5. (Company Name) HAZMAT Emergency Response Training Program

b. All (Company Name) HAZMAT Emergency Response Team Commanders, Safety-Communications Officers and Entry Team members shall complete (Specify) HAZMAT Emergency Response Team Certification. Mandatory training requirements for this certification are:

- (Specify Course No.) - CCAS/VAFB Incident Command System.
- (Specify Course No.) - HAZMAT Emergency Response Technician for HAZMAT Emergency Response Team Members (An EPA or OSHA Compliant 40-hr Course).
- Verification by the cognizant manager of specific hardware or system/equipment training and experience.

c. The skill and knowledge levels required for all levels of HAZMAT emergency response shall be conveyed to employees, before the are permitted to take part in actual operations.

d. (Company Name) or other HAZMAT emergency response trainers who teach any of the subjects listed in Figure G-5 shall have satisfactorily completed a training course for those subjects (such as from the National Fire Academy), or they shall have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a good command of the subject matter for the courses they are to teach.

e. (Company Name) will conduct internal HAZMAT incident response drills and annual refresher training to ensure all Company HAZMAT Emergency Response Team member proficiencies are maintained. HAZMAT Emergency Response Team personnel who do not participate in at least one annual proficiency exercise will receive annual refresher training in place of incident drills to maintain their competencies. Participation in a CCAS/VAFB DRF-directed training incident response exercise will be acceptable for annual recertification, only if full (Company Name) personnel capabilities and proficiencies in incident response to include decon and cleanup are demonstrated.

f. (Company Name) Technical Training Department (Specify Title) shall issue Certificates of Training for all personnel who complete initial HAZMAT emergency response training at all levels. Certificates of completion of annual refresher training or participation in annual proficiency drills also will be issued. Training certificate records will be maintained by the Technical Training Department.

18. (COMPANY NAME) HAZMAT PRE-POSITIONED SPILL RESPONSE CARTS

a. (Company Name) spill response carts will be pre-positioned in each company work area/facility or location supporting payload or launch vehicle processing or support operations, as follows:

(List facility/site locations)
SLC 36 A, Level 11 (1 ea.) - Etc.

b. Spill Response Carts contain sufficient PPE, materials, tools and equipment to support small spill response operations for incidental releases. A Spill Response Cart detailed inventory is provided at Annex 4 to this Plan. In general, each cart will contain:

(1) Spill identifier data tailored to the facility/work area in which the cart is located.

(2) Neutralizing and absorbing materials sufficient for a HAZMAT spill maximum area of 100 square feet (approximately 10 gallons) and a contamination zone perimeter of 80 lineal feet, to include:

- Acid and base (caustic) material neutralizers, solvent neutralizer/vapor control material, sorbent Rolls and Pillows, and sorbent dikes and booms.
- PPE to include air-purifying respirators, aprons, face shields, safety glasses, coveralls, gloves, and boots.
- National Draeger Multi-Gas Detector Kit with tubes for expected hazardous vapor sources.
- Combustible gas and oxygen detectors.
- Brooms, scoops, bags, ties, labels and HAZMAT waste storage drums.
- Emergency first aid supplies and equipment, such as bandages, anesthetics, eye washes, splints, tourniquets, etc.
- Two casualty litters.
- SCAPE and SCBA equipment (only if pre-positioning required, such as at a logistics facility).

19. THE (COMPANY NAME) EMERGENCY ACTIONS PLAN

a. Emergency Actions Plan Rationale

(1) The (Company Name) Emergency Actions Plan defines discovery, notification and evacuation actions for all (Company Name) emergency conditions. For fire, explosion or personal injury incidents, emergency response is by the CCAS/VAFB Fire Department and/or the CCAS/VAFB DRF, operating under the CCAS/VAFB ICS.

(2) However, for HAZMAT release situations, (Company Name) employees bear additional responsibilities in emergency response. This is because (Company Name) employees have special space system skills and experience needed to deal with the hardware involved in a HAZMAT release incident. Because of this knowledge and experience, Company employees may be HAZMAT emergency first responders (as defined by OSHA 1910.120 (q)) , or they may be a part of the CCAS/VAFB fire department's HAZMAT Response Team to deal with the hardware specifics of HAZMAT release threats.

(3) In general, small incidental releases will be handled by the (Company Name) personnel in the work area. Larger spills and releases, or any incident involving fire, explosion or personal injury will require activation of the

CCAS/VAFB DRF via 911 notification. *Thus, the critical determining factors to determine HAZMAT incident response actions are:*

(a) **The size of the spill.** Spills that can be contained and cleaned up by **(Company Name)** employees within the spill site are incidental spills. Spills that exceed in-house company capabilities require emergency response alerting IAW this Plan and OPLAN 355-1.

(b) **The identity of the released chemical.** If the identity is unknown, emergency response alerting is required. If the chemical is known, the appropriate response is taken according to the toxicity, fire or explosion hazard potential for that material.

(c) **The danger from actual or potential chemical exposures.** If the released material does not present a potential safety or health hazard from chemical exposure and is small, the spill may be considered an incidental release. If imminent danger from chemical exposure results from a release of any size, or the environment is polluted (air, water or soil), emergency response alerting is required.

(4) The immediate concern is to protect the health and safety of **(Company Name)** and other employees in the area of the release and take the proper action to minimize further health hazards, property damage and environmental impact.

b. Hazmat Incident Personal Protective Equipment (PPE) Policy

(1) SCAPE and SCBA equipment is prepositioned or available at **(Company Name)** work areas and facilities for daily operations involving specified hazardous mission support operations. The order to wear specific PPE during HAZMAT incident response shall be given by **(Company Name)** HAZMAT Emergency Response Team Commanders, based on the chemical exposure hazard defined by air monitoring devices and other known conditions at the spill site.

(2) Where spill site chemical exposure conditions are ill-defined or unknown, **(Company Name)** HAZMAT Emergency Response Team members shall wear SCAPE and/or positive pressure SCBA while engaged in the initial response. PPE will be worn until such time the Safety-Communications Officer determines, through the use of air monitoring equipment, that a decreased level of respiratory protection will not result in hazardous exposures.

c. Emergency Actions Plan

(1) Figure G-6 summarizes the appropriate emergency response actions of **(Company Name)** employees who witness or are involved in a fire, explosion, HAZMAT release or personnel injury emergency situation.

(2) **(Company Name)** personnel who witness a hazardous chemical or chemical waste spill or release that is beyond the immediate response capability of the work area, or that involves an actual or potential fire, explosion or personnel injury will:

(a) Sound or activate work area and facility alarms.

(b) Ensure all work area personnel hear and react to the evacuation alarms. Visually inspect all compartments and confined work areas to ensure all personnel are alerted to the incident situation.

(c) Assist in work area and facility evacuation, and the removal of casualties.

(d) Report critical information to 911.

(e) Report to the designated marshaling area. Find the responding **(Company Name)** HAZMAT Emergency Response Team Commander, complex/facility OIC/NCOIC or other designated DRF HAZMAT Incident Commander, and relay all details of the incident. Remain with the **(Company Name)** Commander to provide information, as required.

(3) Any responding **(Company Name)** employee who witnesses a hazardous chemical or HAZMAT waste spill or release incident and who is uncertain about the magnitude of the spill, the identity of the chemical released or the potential for fire, explosion or personal injury, shall immediately sound emergency alarms, evacuate the spill area and dial 911.

(4) **Company** personnel who witness a small, incidental hazardous chemical or chemical waste spill or release that can be terminated and cleaned up by properly trained and equipped **(Company Name)** employees within the spill site and does not pollute air, water or land, shall:

(a) Notify available Supervisor(s), **(Company Name)** Safety and **(Company Name)** Environmental Safety and Health.

(b) Limit access to the spill site.

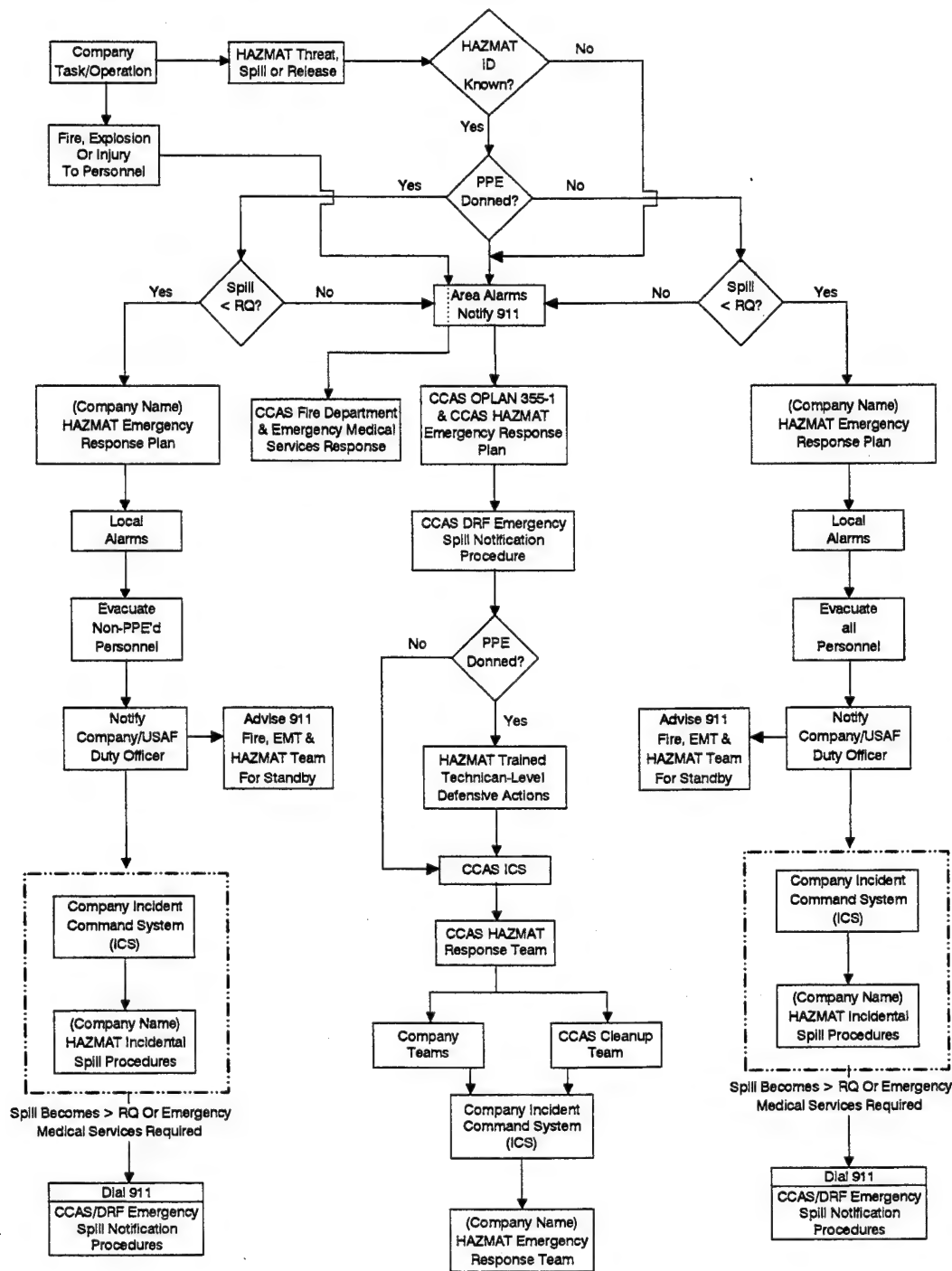


Figure G-6. (Company Name) Emergency Actions Plan

(c) Conduct spill containment, mop and sop operations and site cleanup IAW work area procedures in the proper PPE.

20. (COMPANY NAME) SUPERVISOR HAZMAT INCIDENT RESPONSIBILITIES

a. The supervisor of the launch vehicle or payload processing task or bulk propellant transfer operation that results in a HAZMAT spill or release incident will take charge of the incident site and direct emergency alarm, evacuation and notification actions until he/she is relieved by the designated Company HAZMAT Emergency Response Team Incident Commander for that shift. In the absence of the task supervisor, the senior technician takes charge of the evacuation and reporting actions. The responsible company supervisor briefs the arriving Incident Commander on all known incident factors and remains available for further clarifications and consultations until dismissed.

b. The responsible supervisor insures that proper initial emergency notifications are made (911, Pad Safety, Blockhouse Control, as appropriate) and emergency procedures are initiated (Task Procedures Emergency Instructions Appendix).

c. *Unless trained as an OSHA Incident Commander, the task supervisor does not direct employees to identify, mitigate, control or terminate the accidental release.*

d. Upon the arrival of the designated Company HAZMAT Emergency Response Team Commander or the Complex/Facility military OIC/NCOIC Incident Commander, or the DRF Incident Commander at the incident site, command and control of the HAZMAT emergency response action is passed from the initial responsible supervisor to the trained Incident Commander. The responsible supervisor briefs the arriving Incident Commander on all known incident factors and remains available for further clarifications and consultations until dismissed.

e. If the responsible company supervisor is trained and designated as a company HAZMAT incident commander, then he/she may take the actions described in paragraph 21, below.

21. (COMPANY NAME) HAZMAT EMERGENCY RESPONSE TEAM COMMANDER'S RESPONSIBILITIES

a. The (Company Name) HAZMAT Emergency Response Team Commander (HAZMAT Incident Commander) is the senior (Company Name) emergency response official responding to a HAZMAT emergency, and is the individual in charge of the (Company Name) ICS. All (Company Name) HAZMAT emergency response actions and communications shall be coordinated and controlled

by the on-site **(Company Name)** HAZMAT Emergency Response Team Commander.

b. The **(Company Name)** HAZMAT Emergency Response Team Commander shall ensure a trained Safety-Communications Officer is at the incident site prior to conducting emergency response operations. The Safety-Communications Officer is responsible for identifying and evaluating hazards and for providing direction to the **(Company Name)** HAZMAT Emergency Response Team Commander on the safety of the operations and to identify IDLH conditions using air monitoring equipment.

c. The **(Company Name)** HAZMAT Emergency Response Team Commander shall identify, to the extent possible, all hazardous substances or conditions present, and shall address, as appropriate, incident site analysis, air monitoring, maximum exposure limits, hazardous substance handling procedures and the use of containment, neutralization, decontamination and cleanup materials, tools and equipment.

d. Concurrently, the **(Company Name)** HAZMAT Emergency Response Team Commander must assess possible hazards to human health and the environment that may result from the HAZMAT release, fire or explosion. This assessment must consider both direct and indirect effects of the release, fire or explosion. Examples are the effects of any toxic, irritating or asphyxiating gases that are generated; or the effects of any hazardous surface run-offs from water or chemical agents used for HAZMAT containment, neutralization, decontamination and cleanup; or runoff resulting from Fire Department fire or explosion control.

e. The **(Company Name)** HAZMAT Emergency Response Team Commander shall serve in a subordinate position to the CCAS/VAFB HAZMAT Response Team Commander (Fire Officer). Based on the hazardous substances and/or conditions present, he/she will implement appropriate emergency operations, when directed by the HAZMAT Team Commander. The **(Company Name)** HAZMAT Emergency Response Team Commander will ensure that the appropriate PPE is worn by company employees for the specific hazards encountered or expected at the incident site.

f. The **(Company Name)** HAZMAT Emergency Response Team Commander shall limit the number of emergency response personnel at the emergency response site, in those areas of potential or actual exposure to HAZMAT or other site hazards, to only those Company Entry Team members who are actively performing emergency operations.

g. The **(Company Name)** HAZMAT Emergency Response Team Commander will ensure that all operations in any hazardous area are performed using the buddy system in groups of two or more.

h. The **(Company Name)** HAZMAT Emergency Response Team Commander shall ensure that Backup Team personnel stand by with equipment ready to provide assistance, rescue, advanced first aid or removal from the incident site for emergency medical assistance.

i. When HAZMAT incident emergency response activities are judged by the **(Company Name)** HAZMAT Emergency Response Team Incident Commander or the Safety-Communications Officer to be an IDLH condition and/or involve an imminent danger, either of these officials shall alter, suspend or terminate the activities. The Company HAZMAT Incident Commander or his/her Safety-Communications Officer will then inform the fire department HAZMAT Emergency Response Team leader or DRF Incident Commander of remedial actions to be taken to correct the hazards.

j. During an emergency, the **(Company Name)** HAZMAT Emergency Response Team Commander must take all reasonable measures necessary to ensure that fires, explosions or additional releases do not occur, recur or spread to other systems, equipment and facilities, or to another source of HAZMAT. These measures must include, where applicable, stopping equipment processes and operations, collecting and containing released waste, and removing or isolating HAZMAT containers.

k. If a **(Company Name)** facility or GSE system stops operation in response to a fire, explosion or HAZMAT release, the HAZMAT Emergency Response Team Commander and/or the Air Force task command and control element (blockhouse) must monitor that system for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or malfunctions and anomalies in other equipment, as appropriate.

l. After emergency operations have terminated, the **(Company Name)** HAZMAT Emergency Response Team Commander shall:

- (1) Decontaminate PPE, tools and equipment.
- (2) Treat, store and dispose recovered waste, contaminated soil or surface water, or any other material that results from the DECON process.
- (3) Clean and restock emergency materials and equipment and ensure they are fit for intended use.
- (4) Replenish Spill response carts prior to the resumption of normal **(Company Name)** processing or recovery operations.

m. The **(Company Name)** HAZMAT Emergency Response Team Commander will ensure that no chemical that may be incompatible with the released material is used in the work area until all HAZMAT emergency response operations are terminated, the spill site is cleaned up, and the work area is cleared for normal processing operations.

22. (COMPANY NAME) HAZMAT EMERGENCY RESPONSE TEAM PROCEDURES USING THE CCAS/VAFB INCIDENT COMMAND SYSTEM

a. The major steps to be followed by **(Company Name)** employees during a CCAS/VAFB HAZMAT release emergency response are identified in Figure G-7 and Annex 5.

b. A detailed procedures guide to be followed by **(Company Name)** HAZMAT Emergency Response Team Commanders in directing Site Entry Teams during HAZMAT emergency operations is listed at Annex 6.

23. (COMPANY NAME) HAZMAT EMERGENCY RESPONSE TEAM ROLES AND RESPONSIBILITIES

a. **(Company Name)** Site Entry , Backup and Restup Teams, as defined at Figure G-1, consists of two personnel each , to ensure the buddy system is in effect for all emergency operations. The Backup Team shall stand by at the command post area with equipment ready to provide assistance or rescue in case of an unforeseen emergency. First aid materials contained in the Spill Response Cart shall be readied for immediate use.

b. Site Entry, Backup and Restup Team Members will be SCAPE certified and don such ensembles as directed by the **(Company Name)** HAZMAT Emergency Response Team Commander.

c. The primary purpose of **(Company Name)** Site Entry Teams is to perform launch vehicle, payload, support equipment or facility-specific hardware activities/tasks to prevent or control and stop the release of hazardous chemicals caused by mechanical malfunctions and/or material failures. Hardware and facility system - related emergency response operations are defined in applicable hazardous operation task instructions, Emergency Instructions Annexes and in complex/facility Emergency Procedures Documents.

d. The **(Company Name)** HAZMAT Emergency Response Team Commander will consult the applicable authority or document, or both, to determine how to terminate HAZMAT flow by isolation or by-passing the commodity using a remote valve from a standoff control location or by console control command. If this approach is not feasible, the Company Incident Commander will use such authorities to plan for the termination of the HAZMAT flow by Site Entry Team activities.

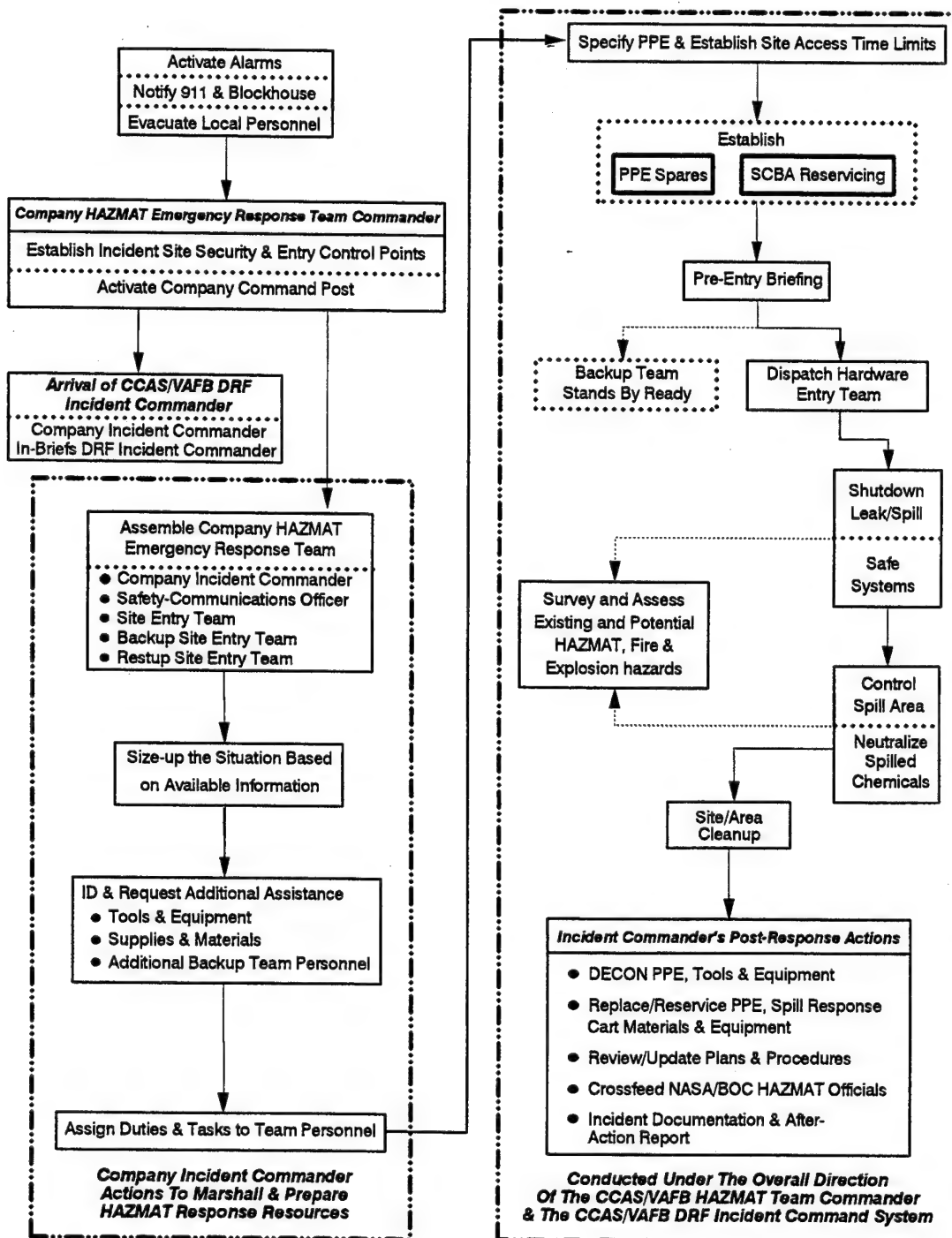


Figure G-7. (Company Name) HAZMAT Emergency Response Procedures

24. EMERGENCY MEDICAL TREATMENT AND FIRST AID

a. Fire, explosion and/or HAZMAT spill or release incidents resulting in employee injury, unprotected exposure to hazardous materials or vapors, or spills greater than the EPA Reportable Quantity (RQ) will be immediately reported to 911. This will result in the immediate response of the fire department and emergency medical paramedics with ambulances to the incident site.

b. First responders will assist injured personnel and remove them from the immediate spill area, if it is determined safe to accomplish this action. First Aid kits are prepositioned at (Company Name) facilities and also are included in Spill Response Carts.

c. If hazardous vapor conditions are known to exist or suspected, first responders who are not protected by OSHA Level A fully-encapsulated ensembles or SCAPE will not attempt the movement of injured personnel. Instead, they will fall back to a safe standoff location and provide guidance to arriving CCAS/VAFB fire department and paramedic emergency response personnel.

d. Rescue of injured or incapacitated personnel by Company employees protected by Level A or SCAPE ensembles shall be according to the CONOPS described at paragraph 10c(8).

25. POST-HAZMAT EMERGENCY RESPONSE CRITIQUE AND FOLLOW-UP REPORTS

a. The (Company Name) HAZMAT Incident Commander will prepare a HAZMAT Emergency Response Incident Report within 48 hours following the termination of the response action. He/she will be assisted by the Safety-Communications Officer, and other response participants (USAF, other companies and/or BOC personnel), as necessary. This report will be submitted to the (Company Name) Emergency Preparedness Coordinator.

b. The HAZMAT Emergency Response Incident Report will reconstruct the incident and (Company Name) employees' response to establish a clear picture of the events that took place. Each person making an entry or contributing information must do so via a signed and dated deposition, since such information may be used in a future legal action or claim, particularly if injuries were sustained.

c. The HAZMAT Emergency Response Incident Report will contain six major areas of documentation and analysis:

(1) EPA-required information (40 CFR 265.56 (j)(1-7)).

- Time and date of any incident requiring implementation of this Plan.
- **(COMPANY NAME)** name, address, phone number and incident point of contact.
- Type and details of the HAZMAT incident.
- Name and quantity (ies) of the material (s) involved.
- Extent of injuries, if any.
- An assessment of actual or potential hazards to human health or the environment.
- Estimated quantity and disposition of recovered material that resulted from the incident.

(2) Command and Control.

- **(Company Name)** internal.
- Air Force/block house controller.
- Duty Officer
- Supporting activities (Safety, logistics, etc.)
- Outside contacts (NASA, BOC, etc.)

(3) Response Operations

- Notification
- Evacuation
- Marshaling Areas
- Remote defensive actions
 - System monitoring activities
 - Stabilizing & isolating leak/spill source
- Site Entry Team spill response & hardware repairs
 - Containment
 - Neutralization
 - Decontamination
 - Cleanup
- Other support received

(4) Resources

- PPE
- Spill Response Cart materials & tools
- Spill/leak control hardware (parts, supplies & equipment to control/terminate HAZMAT release.

(5) Safety & Training

- What happened?
- Was it preventable? If so, how?
- Were **(Company Name)** procedures adequate?
 - Technically.
 - Protect employee safety & health.
- Were **(Company Name)** personnel adequately trained?
- Were other non-Company personnel adequately trained?
- List additional required training areas/courses.
- Were all resources at hand for effective emergency response?
- Hazard detection & identification proficiency/accuracy/timeliness.
- Employee exposures & safety during response.
- Employee follow-up medical assistance.
- Employee post-response liability issues?

(6) Recommendations

- Command and control
- Response operations
- Resources
- Safety & Training
- USAF/CCAS/VAFB/LBS interfaces
- NASA/BOC interfaces

26. PERSONAL PROTECTIVE EQUIPMENT (PPE) AND EMERGENCY SUPPORT EQUIPMENT

a. Selection of proper PPE for **(Company Name)** employees involved in HAZMAT incident emergency response, is one of the crucial decisions that must be made by the **(Company Name)** HAZMAT Incident Commander. Proper PPE will protect employees from IDLH and less hazardous environments associated with malfunctions and material failures of on-board or facility systems and support equipment, or from accidents involving HAZMAT during transportation or storage prior to use.

b. (Company Name) personnel must wear PPE during HAZMAT emergency response operations when dangerous vapors, gases or particles are present at the incident site or when direct contact with skin-affecting substances may occur.

c. PPE

(1) A (Company Name) -related HAZMAT emergency involving company employees normally will occur during the highly structured, supervised and documented process of launch vehicle or payload processing or propellant transfer operation. Hazardous chemicals involved in such tasks are identified in the applicable task instruction/directive and annexes detailing Emergency Instructions. Furthermore, (Company Name) task supervisory and safety operations personnel are in radio contact with the Air Force task controller/blockhouse during all processing activities. Thus, under most emergency conditions, the precise identity of the HAZMAT release will be immediately known at the incident site, and the determination of requisite PPE for employees involved in emergency response can be rapidly made.

(2) 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response, contains explicit guidance regarding employee protection during HAZMAT incidents. The following rules will govern the (Company Name) HAZMAT Emergency response team Commander's selection of PPE for use by himself (if required) and for all other Company employees involved in HAZMAT emergency response incidents:

(a) PPE shall be selected and used which will protect employees from the hazards and potential hazards they are likely to encounter during all phases of the HAZMAT emergency response operation.

(b) PPE selection shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the incident site, the remedial/recovery task-specific conditions and expected task durations, and the chemical hazards and potential hazards identified as being present at the HAZMAT spill/release site.

(c) Positive pressure self-contained breathing apparatus, or positive pressure air-line respirators equipped with an escape air supply, shall be used when chemical exposure levels present will create a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(d) Totally-encapsulating chemical protective suits (Level A protection) shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(e) The level of protection provided by PPE selection shall be increased when additional information at the incident site on hazardous chemical vapor concentrations indicates that increased protection is necessary to reduce employee exposures to below permissible exposure limits and published exposure levels for hazardous substances and health hazards.

(f) PPE shall be selected and used to meet the requirements of 29 CFR 1910, Subpart I.

(g) Totally-encapsulating chemical protective suits (SCAPE) shall protect employees from the particular hazards which are identified during incident site characterization and analysis.

(h) Totally-encapsulating chemical protective suits (SCAPE) shall be capable of maintaining positive air pressure and be capable of preventing inward gas leakage of more than 0.5 percent, IAW 29 CFR 1910.120, Appendix A.

(i) Additional requirements and policies regarding the (Company Name) written Personnel Protection Equipment (PPE) Program are contained in (specify applicable Company directive).

(3) 29 CFR 1910.120 Categories of Personal Protective equipment are detailed at Annex 7.

d. HAZMAT Emergency Response Support Equipment

(1) Support tools and equipment required for a small spill or release (approximately 100 square feet of liquid spill) emergency response are contained in each (Company Name) Spill Response Cart.

(2) Requirements for other items identified for emergency response operational support of Site Entry Teams will be directed by the (Company Name) HAZMAT Emergency Response Team Commander to the CCAS/VAFB HAZMAT Response Team Commander using the DRF Incident Command System. Where specialized tools or equipment are required that are not available in the composite HAZMAT Response Team on-site inventory, the (Company Name) HAZMAT Emergency Response Team Commander will direct requirements to the requisite (Company Name) or DRF functional area (logistics, tool issue, facilities with additional SCAPE and SCBA ensembles, etc.) by radio net for immediate action.

27. (COMPANY NAME) HAZMAT EMERGENCY RESPONSE GUIDESHEETS

Annex 9 provides emergency response guidesheets for the major classes of dangerous chemicals used in Shuttle processing. These documents detail fire and explosives hazards, firefighting agents, PPE material compatibility, and proper neutralization and absorption materials and criteria to be used by (COMPANY NAME) personnel during incidental release cleanup or emergency response.

28. HAZMAT EMERGENCY RESPONSE TEAM MEDICAL SURVEILLANCE PROGRAM

a. OSHA 29 CFR 1910.120(q) requires that (Company Name) establish a medical surveillance program for members of HAZMAT teams, i.e., the Company's HAZMAT Emergency Response Team(s).

b. (Company Name) HAZMAT Emergency Response Team members shall receive medical examinations at the (Specify) medical facility, as follows:

(1) Prior to assignment as a (Company Name) HAZMAT Emergency Response Team Commander, Safety - Communications Officer or Site Entry Team member (includes backup & restup teams).

(2) Annually, thereafter.

(3) Upon termination as a (Company Name) HAZMAT Emergency Response Team member, provided an annual examination was not accomplished within the past six months.

(4) Immediately after an employee develops symptoms indicating possible overexposure to hazardous substances or health hazards.

(5) Immediately after the employee is injured or exposed above the permissible exposure limits or published exposure levels while participating in a HAZMAT release/spill emergency response operation.

(6) At more frequent intervals, if the examining physician determines an increase frequency of examination is medically necessary.

c. Contents of medical examinations provided to (Company Name) HAZMAT response team employees, the information provided to the physician (includes a copy of 29 CFR 1910.120 and appendices) and the content of the physician's written opinion shall be in accordance with 29 CFR 1910.120 (f), Medical Surveillance, and the (Company Name) (Specify document/policy that details procedures for hazardous materials incident response and reporting).

29. FIRE AND EXPLOSION PREVENTION

a. The hazardous chemicals, propellants, fuels and oxidizers stored in CCAS/VAFB facilities and (Company Name) workplaces, transported in (Company Name) vehicles, used by (Company Name) employees during specified tasks or transferred to on-board mission systems provide additional hazards and risks under normal day-to-day operations, and particularly during spill or release emergency response conditions:

(1) Chemicals with boiling points below ambient temperatures may produce flammable or explosive concentrations of off-gas vapors.

(2) Potentially flammable or explosive vapors may be invisible and can be lighter than air (hydrogen) or heavier than air (hydrocarbon fuels/lubricants/hydrazines), depending on site-specific emergency conditions.

(3) The combustion products of burning chemicals or chemical vapors usually are extremely toxic and hazardous to life and health.

(4) Many acids, oxidizers and reducers are not flammable themselves, but react with metals or water to produce hydrogen, which is extremely combustible and explosive.

(5) Storage vessels and containers of hazardous chemicals exposed to high heat or fire may explode and/or become projectiles.

(6) Hydrazine-based fuel fires are virtually colorless and smokeless. They will be extremely difficult to see or detect.

(7) Nitrogen tetroxide itself is not combustible, but can react with other hydrocarbon fuels/fires to produce significantly hotter and more violent fire threats.

b. MSDS Sections 4 - Fire and Explosion Data, contain specific information on the characteristics of the subject chemical (flash point, autoignition temperature, flammability limits, extinguishing agents). Spill Response Carts will contain the MSDSs for chemicals present in the work area where a HAZMAT emergency may occur. Facility occupants will be familiar with these data and consult MSDSs for fire and explosion prevention information during a HAZMAT emergency response.

c. A copy of **NFPA 49, Hazardous Chemicals Data**, also will be included in each Spill Response Card. This document provides a fast, easy reference to HAZMAT health, fire and explosive hazards, as well as instability and reactivity data and required PPE.

d. **(Company Name)** employees will minimize the potential for fire or explosion resulting from a HAZMAT spill or release by:

(1) Shutting down and/or removing heat- or spark-producing tools and equipment from the incident site.

(2) Shutting down ventilation and other internal air-handling equipment to prevent spread to other facility areas. Note: this may increase vapor concentration levels within the incident site.

(3) Activating emergency exhaust systems, if specifically designed for explosive vapor extraction.

(4) Isolating spilled materials from other chemicals and metal components or equipment, and water sources.

(5) Using non-sparking tools and equipment during Contingency Crew and Spill Response Team Operations.

(6) Exercising extreme care in the selection and use of HAZMAT neutralization and decontamination agents and materials. Application of the incorrect neutralizer may result in a violent chemical reaction and the production of toxic off-gases, and/or explosion.

e. Annex 8, Facility Fire Prevention Surveys identifies fire alarms, detection and suppression systems for **(Company Name)** facilities. This list is required by EPA to be a part of this Plan to assist **(Company Name)** personnel in emergency response to fires that may precede, accompany or result from a HAZMAT release incident.

30. CONDUCT OF HAZMAT EMERGENCY RESPONSE AT OFF-BASE LOCATIONS

a. **(Company Name)** personnel may be required to perform HAZMAT emergency response operations at off-base locations nearby CCAS/VAFB, according to their skill and knowledge levels obtained by successful completion of training and certifications specified in this Plan and the specific requirements of the site where incident response is required. Such operations will be conducted only under the command and control of the fully-constituted CCAS/VAFB DRF.

b. **(Company Name)** employees **will not** conduct HAZMAT emergency response operations, as defined in this Plan, at off-CCAS/VAFB locations, unless the following have occurred:

(1) Required PPE, tools and equipment and HAZMAT response reference materials are available for use.

(2) USAF or NASA-provided emergency medical assistance is available.

(3) **(Company Name)** employees are a part of a formally-constituted and trained HAZMAT Response Team using the CCAS/VAFB ICS, as defined in OPLAN 355-1.

(4) The HAZMAT emergency response is directed and controlled under the CCAS/VAFB DRF command and control system.

c. **(Company Name)** employees performing HAZMAT emergency response functions at off-CCAS/VAFB locations will be organized under the **(Company Name)** ICS, as defined by this Plan. There will always be, as a minimum, six (6) **(Company Name)** employees involved at all times in a non-CCAS/VAFB HAZMAT emergency response operation:

(1) **(Company Name)** Incident Commander and Safety - Communications Officer.

(2) Two (2) HAZMAT Site Entry Team technicians.

(3) Two (2) HAZMAT Backup Site Entry Team technicians.

31. ANNEXES

Annex 1 - **(Company Name)** Hazmat Emergency Response Personnel Listing - TBD By Each Contractor.

Annex 2 - **(Company Name)** Facility Evacuation Routes - TBD By Each Contractor.

Annex 3 - **(Company Name)** Facility Evacuation Marshaling Areas - TBD By Each Contractor.

Annex 4 - Spill Response Cart Inventory Listing - TBD By Each Contractor.

Annex 5 - Hazmat Incident Emergency Response Procedures.

Annex 6 - Hazmat Emergency Response Team Commander's Guide To Hazardous Emergency Response Operations.

Annex 7 - 29 CFR 1910.120 Categories Of Personal Protective Equipment.

Annex 8 - (Company Name) Facility Fire Prevention Surveys -
TBD By Each Contractor.

Annex 9 - (Company Name) Hazmat Emergency Response
Guidesheets - TBD By Each Contractor.

Annex 10 - Federal Regulations Compliance Cross-Reference
Matrices.

ANNEX 5 - HAZMAT INCIDENT EMERGENCY RESPONSE PROCEDURES

<u>TEAM POSITION</u>	<u>PROCEDURE/ACTION</u>
IC	ESTABLISH COMMAND POST & SECTOR LOCATIONS <ul style="list-style-type: none"> O CP O OPS SECTOR O PLANNING SECTOR O ALL UPWIND
IC	ESTABLISH SITE SECURITY <ul style="list-style-type: none"> O SECURE MULTIPLE ROUTES O ACCESS TO CP O ACCESS TO SPILL SITE O UPWIND OF CP
IC	ESTABLISH WORK ZONES & ENTRY CONTROL POINTS <ul style="list-style-type: none"> O ZONE BOUNDARIES O WARM ECP O HOT ECP IN O HOT ECP OUT O DECON CORRIDOR
IC OPS SECTOR SAFETY	SIZE-UP/SITUATION ASSESSMENT <ul style="list-style-type: none"> O ID CHEMICAL (S) <ul style="list-style-type: none"> - VISUAL CONTAINER LABELS/PLACARDS - VISUAL SMOKE/VAPORS - TRANSPORTATION/STORAGE DOCUMENTS - MSDS O ID SPILL/LEAK MECHANISM <ul style="list-style-type: none"> - VALVE/HOSE LEAK - PUNCTURE/HOLE - TIPPED OVER - OTHER DAMAGE O OTHER DRUMS/CHEMICALS IN VICINITY?
IC OPS SECTOR SAFETY	HAZARD ASSESSMENT <ul style="list-style-type: none"> O FIRE/EXPLOSION O POTENTIAL IGNITION SOURCES O RESPIRATORY - VAPORS/FUMES O SKIN ABSORPTION - POOLS/FLUID FLOW

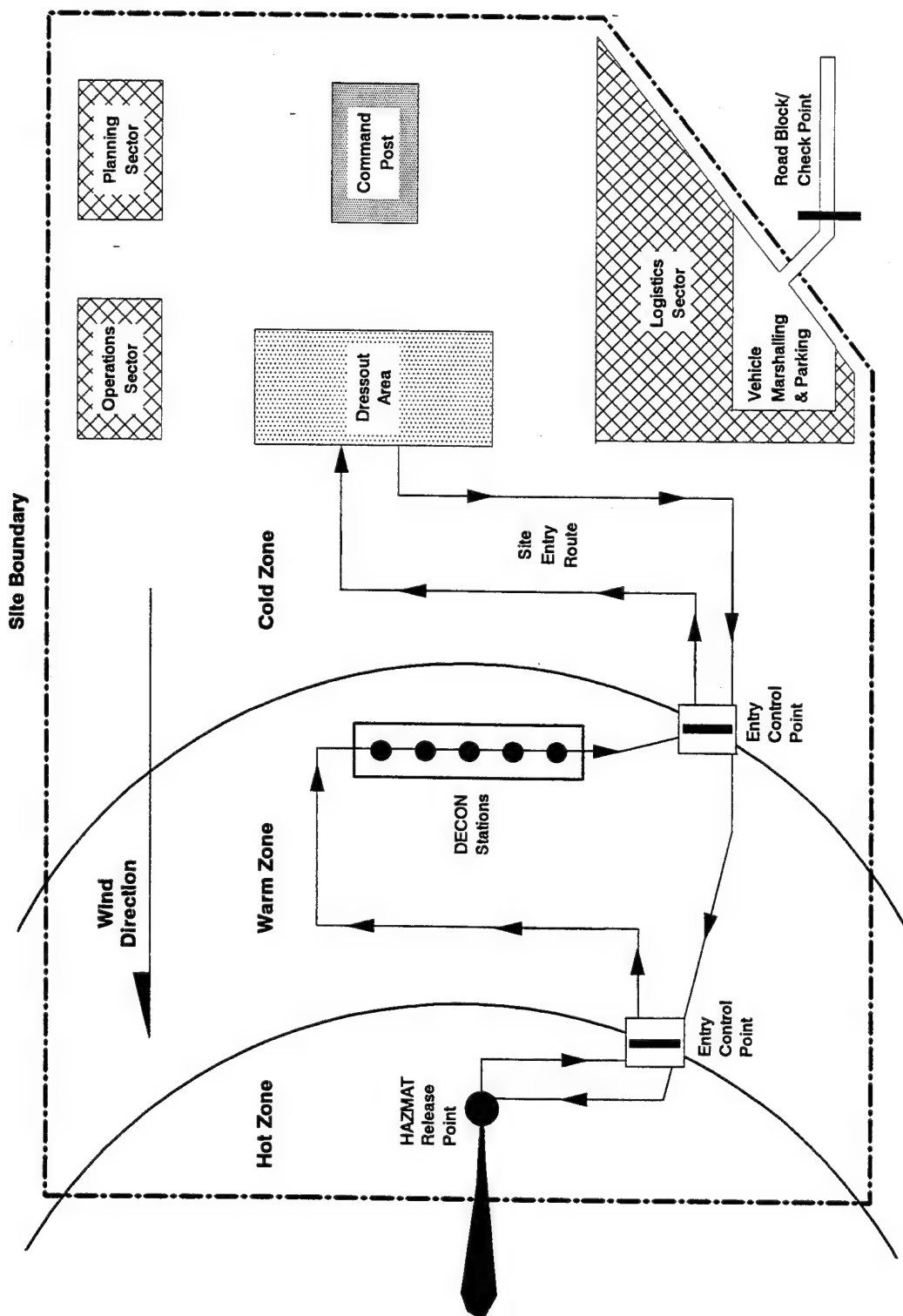


Figure GA5-1. HAZMAT Emergency Response Incident Site Plan

HAZMAT INCIDENT EMERGENCY RESPONSE PROCEDURES

<u>TEAM POSITION</u>	<u>PROCEDURE/ACTION</u>
IC OPS SECTOR SAFETY	PLAN THE RESPONSE O ENTRY 1 - SITE & HAZARD ASSESSMENT, CHEMICAL ID, INITIAL CONTAINMENT (IF AIR TIME AVAILABLE) O ENTRY 2 - SECURE LEAK, ADDITIONAL CONTAINMENT & PATCH/PLUG O ENTRY 3 - FINAL CONTAINMENT & DIVERSION, OVERPACK O ENTRY 4 - NEUTRALIZE O ENTRY 5 - CLEANUP/CONTAINERIZE RESIDUAL
IC SAFETY	DETERMINE ENTRY TEAM ROTATIONS & SCHEDULE O 1 OR 2 SITE ENTRIES IN SCAPE: - ENTRY TEAM - BACKUP TEAM O LEVEL A PPE W/30 MIN SCBA AIR OR 3+ SITE ENTRIES IN SCAPE: - ENTRY TEAM - BACKUP TEAM - RESTUP TEAM
IC SAFETY	SPECIFY PPE O ENTRY & BACKUP TEAMS O DECON TEAM O INSURE SUIT/BOOT/GLOVE COMPATIBILITY W/HAZMAT
IC	DECON TEAM DRAW & DON PPE ENTRY & BACKUP TEAMS DRAW & READY PPE
IC DECON TEAM	SET UP DECON CORRIDOR
IC	ENTRY TEAM 1 DON PPE
HAZ LEADER	BACKUP TEAM DON PPE TO WAIST
SAFETY	SET SITE ACCESS TIME LIMIT

HAZMAT INCIDENT EMERGENCY RESPONSE PROCEDURES

<u>TEAM POSITION</u>	<u>PROCEDURE/ACTION</u>
IC	ENTRY TEAM 1 BRIEFING <ul style="list-style-type: none">O ENTRY TEAM TASKS AT SPILL SITEO BACKUP TEAM STANDBYO COMMO, HAND SIGNALS & EMERGENCY RESCUEO EXIT & DECON (FULL OR PARTIAL DOFF PPE)O AIR TIMEO LOOK OUT FOR SITE CHANGESO ALWAYS BUDDY SYSTEM
HAZ LEADER	ASSEMBLE MATERIALS NEEDED FOR INITIAL CONTAINMENT <ul style="list-style-type: none">O DIKES/BOOMS
SUIT/AIR	BEGIN SITE ACCESS CLOCK
HAZ LEADER	SITE ENTRY 1 <ul style="list-style-type: none">O TRANSPORT INITIAL CONTAINMENT MATERIALSO AIR MONITOR EXPLOSION & OXYGENO VERIFY CHEMICAL IDO ID EQUIPMENT SAFING - VALVES, PUMPS, ELECTRICALO ID LEAK MECHANISMO ID SPILL BOUNDARIES - SOIL/WATER INFILTRATIONO ID PLUG/PATCH METHODO ID FINAL CONTAINMENT METHODS/MATERIALSO ID TOOLS/OVERPACK/WASTE CONTAINERSO CONTAIN W/DIKES & BOOMS, IF AIR TIME ONLYO EXIT HOT ZONE & DECONO REPORT TO CP & DEBRIEF
DECON LEADER	DECON ENTRY TEAM 1 LITMUS/WIPE TEST TO VERIFY
HAZ LEADER	ASSEMBLE MATERIALS NEEDED FOR TOTAL RESPONSE (CALL FOR LOGISTICS SUPPORT, IF NEEDED) <ul style="list-style-type: none">O PLUG/PATCHO DIKES/BOOMSO NEUTRALIZERS/SORBENTSO OVERPACKSO WASTE DRUMSO TOOLS/SHOVELS

HAZMAT INCIDENT EMERGENCY RESPONSE PROCEDURES

<u>TEAM POSITION</u>	<u>PROCEDURE/ACTION</u>
IC	ENTRY TEAM 2 (PREVIOUS BACKUP TEAM) DON PPE
HAZ LEADER	BACKUP TEAM (PREVIOUS ENTRY TEAM OR RESTUP TEAM) DON PPE TO WAIST
HAZ LEADER	ASSEMBLE MATERIALS NEEDED FOR ADDITIONAL CONTAINMENT
	<ul style="list-style-type: none"> O DIKES/BOOMS
SAFETY	SET SITE ACCESS TIME LIMIT
IC	ENTRY TEAM 2 BRIEFING
	<ul style="list-style-type: none"> O ENTRY TEAM TASKS AT SPILL SITE O BACKUP TEAM STANDBY O COMMO, HAND SIGNALS & EMERGENCY RESCUE O EXIT & DECON (FULL OR PARTIAL DOFF PPE) O AIR TIME O LOOK OUT FOR SITE CHANGES O ALWAYS BUDDY SYSTEM
SUIT/AIR	BEGIN SITE ACCESS CLOCK
HAZ LEADER	SITE ENTRY 2 <ul style="list-style-type: none"> O TRANSPORT PLUG/PATCH MATERIALS O TRANSPORT ADDITIONAL CONTAINMENT MATERIALS O SECURE VALVE/MOTOR/PUMP/ELECTRICAL O LAY OUT DIKES/BOOMS TO CONTAIN LEAK/POOL O PLUG/PATCH LEAK O UPRIGHT DRUM (S)/MOVE DRUM (S) ETC. O EXIT HOT ZONE & DECON O REPORT TO CP & DEBRIEF
DECON LEADER	DECON ENTRY TEAM 2 LITMUS/WIPE TEST TO VERIFY
IC	ENTRY TEAM 3 (CAN BE PREVIOUS BACKUP TEAM) DON PPE
HAZ LEADER TO	BACK-UP TEAM (CAN BE PREV ENTRY TEAM) DON PPE WAIST
SAFETY	SET SITE ACCESS TIME LIMIT

HAZMAT INCIDENT EMERGENCY RESPONSE PROCEDURES

<u>TEAM POSITION</u>	<u>PROCEDURE/ACTION</u>
IC	ENTRY TEAM 3 BRIEFING <ul style="list-style-type: none"> O ENTRY TEAM TASKS AT SPILL SITE O BACKUP TEAM STANDBY O COMMO, HAND SIGNALS & EMERGENCY RESCUE O EXIT & DECON (FULL OR PARTIAL DOFF PPE) O AIR TIME O LOOK OUT FOR SITE CHANGES O ALWAYS BUDDY SYSTEM
SUIT/AIR	BEGIN SITE ACCESS CLOCK
HAZ LEADER	SITE ENTRY 3 <ul style="list-style-type: none"> O TRANSPORT CONTAINMENT MATERIALS & DIVERSION TOOLS (SHOVELS, ETC.), IF NEEDED O TRANSPORT OVERPACK (S) O PLACE FINAL CONTAINMENT DEVICES, IF NEEDED O OVERPACK LEAKING DRUM (S) O DIG DIVERSION OR INTERCEPTOR DITCHES, BUILD SOIL DIKES, ETC. (MAY NEED TO CONTINUE NEXT ENTRY) O ESTIMATE NEUTRALIZER/SORBENT MATERIALS NEEDED O EXIT HOT ZONE & DECON O REPORT TO CP & DEBRIEF
DECON LEADER	DECON ENTRY TEAM 3 LITMUS/WIPE TEST TO VERIFY
IC	ENTRY TEAM 4 (PREVIOUS BACKUP TEAM) DON PPE
HAZ LEADER	BACKUP TEAM (PREVIOUS ENTRY TEAM OR RESTUP TEAM) DON PPE TO WAIST
SAFETY	SET SITE ACCESS TIME LIMIT
IC	ENTRY TEAM 4 BRIEFING <ul style="list-style-type: none"> O ENTRY TEAM TASKS AT SPILL SITE O BACKUP TEAM STANDBY O COMMO, HAND SIGNALS & EMERGENCY RESCUE O EXIT & DECON (FULL OR PARTIAL DOFF PPE) O AIR TIME O LOOK OUT FOR SITE CHANGES O ALWAYS BUDDY SYSTEM

HAZMAT INCIDENT EMERGENCY RESPONSE PROCEDURES

<u>TEAM POSITION</u>	<u>PROCEDURE/ACTION</u>
SUIT/AIR	BEGIN SITE ACCESS CLOCK
HAZ LEADER	SITE ENTRY 4 <ul style="list-style-type: none">O TRANSPORT NEUTRALIZATION MATERIALSO CONTINUE FINAL DIKING (IF NEEDED)O PLACE SORBENT/NEUTRALIZATION MATERIALS/DEVICESO EXIT HOT ZONE & DECONO REPORT TO CP & DEBRIEF
DECON LEADER	DECON ENTRY TEAM 4 LITMUS/WIPE TEST TO VERIFY
IC	ENTRY TEAM 5 (PREVIOUS BACKUP TEAM) & CLEANUP TEAM DON PPE
HAZ LEADER	BACKUP TEAM (PREVIOUS ENTRY TEAM OR RESTUP TEAM) DON PPE TO WAIST
SAFETY	SET SITE ACCESS TIME LIMIT <ul style="list-style-type: none">O ENTRY TEAMO CLEANUP TEAM
IC	ENTRY TEAM 5 & CLEANUP TEAM BRIEFING <ul style="list-style-type: none">O TEAM TASKS AT SPILL SITEO BACKUP TEAM STANDBYO COMMO, HAND SIGNALS & EMERGENCY RESCUEO EXIT & DECON (FULL OR PARTIAL DOFF PPE)O AIR TIMEO LOOK OUT FOR SITE CHANGESO ALWAYS BUDDY SYSTEM
SUIT/AIR	BEGIN SITE ACCESS CLOCK
HAZ LEADER	SITE ENTRY 5 <ul style="list-style-type: none">O ENTRY TEAM<ul style="list-style-type: none">- FINAL SYSTEM CHECK FOR LEAKS/SAFETY- FINAL CONTAINMENT CHECK- REMOVE ALL TOOLS/UNUSED MATERIALSO CLEANUP TEAM<ul style="list-style-type: none">- TRANSPORT CLEANUP MATERIALS & CONTAINERS- CONTAINERIZE RESIDUAL MATERIALSO EXIT HOT ZONE & DECONO REPORT TO CP & DEBRIEF

HAZMAT INCIDENT EMERGENCY RESPONSE PROCEDURES

<u>TEAM POSITION</u>	<u>PROCEDURE/ACTION</u>
DECON LEADER	DECON ENTRY TEAM 5 LITMUS/WIPE TEST TO VERIFY
IC	CONFIRM SITE STATUS W/ENTRY TEAM MEMBERS CONFIRM DECON COMPLETE
DECON LEADER	DECON TEAM
CLEANUP LEADER	CLEANUP DECON CORRIDOR CONTAINERIZE ALL USED PPE/MATERIALS DECON CLEANUP TEAM
IC ALL LEADERS NEEDED)	AFTER ACTIONS REPORT O GATHER WRITTEN DATA/DEPOSITIONS (IF O INFORM TEAM MEMBERS OF MEDICAL SYMPTOMS & MEDICAL SURVEILLANCE POLICIES O ID PPE DAMAGE O ID EXPENDED MATERIALS & PPE FOR REORDER O NASA & COMPANY NOTIFICATIONS O DRAFT LESSONS LEARNED & CROSSFEED O REVISE EMERGENCY RESPONSE PLAN FOR DEFICIENCIES IDENTIFIED

**ANNEX 6 - CCAS DISASTER RESPONSE FORCE (DRF) INCIDENT
COMMANDER'S GUIDE TO HAZMAT EMERGENCY RESPONSE OPERATIONS**

1. Command, Control and Site Management.

a. The DRF Incident Commander will take actions to isolate the area around the spill or hazardous chemical release point and deny access to all personnel other than designated Contingency Crew members. He/she will insure that evacuation of all non-essential personnel from the work area/level or facility/ bay or from the launch complex is completed, depending on the severity of the hazard to the occupant's health and safety.

b. The DRF Incident Commander will establish a Command Post adjacent to the spill site at a standoff distance of 700 - 2,000 feet, if feasible, in an upwind location. Wind conditions will be monitored to identify downwind areas that may require further evacuation, should additional HAZMAT release occur.

c. The DRF Incident Commander will direct the fire department's HAZMAT response team leader to issue incident identity badges and record the names of personnel according to the number received. These are 4" X 4" plastic laminated badges with a single digit red number (1 - N) on a green background and are a part of the HAZMAT incident management system. Badges will be affixed to the back of each team member's (fire department and civilian contractor) duty uniform or protective personal equipment (PPE) at shoulder blade height by clip or tape. The DRF commander shall direct the DRF Safety-Communications Officer to monitor and control personnel accountability actions regarding incident site entry and exit operations.

d. All HAZMAT team members will be so badged prior to release from the Command Post area into the spill response and cleanup location. Upon their return to the Command Post area they will report to the HAZMAT team leader Safety - Communications Officer for badge turn-in.

e. The DRF Incident Commander will maintain close coordination with company incident commanders and technical representatives, blockhouse command and control radio nets, security forces, weather and medical forces, as HAZMAT emergency response and cleanup activities progress.

2. HAZMAT Identification.

These actions are the responsibility of all incident participants. The DRF Incident Commander must be aware of the conditions and individual responsibilities of employees who control hazardous operations tasks and who may be involved in the emergency release situation and initial response. The DRF Incident Commander must seek out these personnel and gain all possible knowledge about the spill/release conditions at the incident site. Typical considerations are:

a. HAZMAT spills or releases usually can be anticipated to occur in/near CCAS launch complex or payload processing facilities during processing or launch operations, or during the transportation of the propellants/HAZMAT to or from Fuel Storage Area #1 to the end-use facility/site. Accidents involving the transportation of fueled payloads may also occur on CCAS roadways. The DRF may also be required to respond to accidents involving bulk propellant tankers or fueled payloads at nearby, off-base highway locations.

b. For CCAS payload, launch vehicle or propellant transfer or processing operations, the specific chemical involved in the spill/release usually will be identifiable according to the system task underway at the time of the unexpected release incident. Potential emergency conditions involving hazardous commodities are (should be) identified in the applicable task emergency procedures appendix and in facility/complex emergency procedures documents. Chemicals or residues present in launch vehicle, payload or facility systems are generally very well known to the USAF and civilian contractor work force supervisors and technicians at the work site.

c. For transportation incidents, cargo manifests will accompany the driver and define the HAZMAT consumables or waste containers on board. Duplicates will be maintained at the logistics facility dispatcher office, if backup copies are required for HAZMAT identification at a transportation incident site. Additionally, all HAZMAT containers are labeled and/or tagged for ready identification IAW (define the CCAS or company regulation or policy on Transporting, Handling and Storing Hazardous Materials).

3. Hazard and Risk Assessment

a. Hazards are the chemical and physical properties, such as toxicity and flash point, and their effects on people, facilities and the environment. Risk is the relative probability of occurrence of the outcomes or results of the HAZMAT situation and the response operation, coupled to the severity of each probable outcome.

b. The DRF Incident Commander, with advise and concurrence from the DRF Range Safety -Communications Officer, will determine the hazardous vapor concentration level at the spill or release site. This will be done by direct knowledge of the spilled commodity properties and surrounding ventilation/wind conditions and by direct air monitoring devices. Direct air monitoring devices will be used only by a fully SCAPE-attired person, usually from the biomedical team, who has been trained to the OSHA HAZMAT technician level.

c. Once the presence and concentrations of a specific HAZMAT commodity (ies) has been determined, the following risks will be considered by the DRF Incident Commander:

- Exposures exceeding permissible exposure limits
- IDLH concentrations
- Potential skin absorption and irritation sources
- Potential eye irritation sources
- Fire and/or explosion potential
- Potential for oxygen deficiency

d. The above risk factors will be used to evaluate the level of personal protective equipment (PPE) required for emergency response personnel and operating procedures during subsequent spill control, DECON and cleanup activities.

e. Based on all known data, the DRF Incident Commander will select a course of action with lowest overall environmental or safety risk and the most reasonable probability of success. However, he/she also should formulate a backup to the primary approach to account for a more severe condition being identified, as emergency response operations progress. On-Scene Incident Commander decisions shall be made following detailed deliberations with the DRF Range Safety - Communications Officer.

4. Selection of Protective Clothing and Equipment (PPE)

a. PPE selection shall be based on the DRF Incident Commander's evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the incident site, the task-specific conditions and duration of the emergency response operation, and the HAZMAT and potential hazards at the site. PPE selection shall be concurred in by the Range Safety- Communications Officer.

b. The DRF Incident Commander will match the defined HAZMAT chemical, its physical state (solid, liquid, gas), and the measured or expected hazardous vapor concentration levels to the required PPE, according to OSHA 29 CFR 1910.120, Appendix B:

- Level A (Greatest level of skin, respiratory and eye protection)
- Level B (Highest level of respiratory protection, but lessor level of skin protection)
- Level C (Concentrations and types of airborne substances are known, and air-purifying respirators adequate, relaxed criteria for coveralls, boots, face mask, etc.)
- Level D (Minimum protection from nuisance contamination, only).
- When in doubt, the DRF Incident Commander will specify the next higher level of protection.

c. DRF members engaged in HAZMAT emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard may wear SCAPE as a Level A PPE while engaged in hot zone emergency response. Normally,

(1) Fire department HAZMAT team members will use commercial Level A fully encapsulating ensembles and Interspiro SCBA.

(2) USAF or civilian contractor personnel, and NASA BOC support personnel will wear SCAPE with SCBA.

d. Totally-encapsulating Level A chemical protective suits or SCAPE shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of IDLH or impair the ability to escape.

e. SCAPE and/or Level A ensembles will be worn by all hot zone entry and decontamination personnel until such time that the DRF Incident Commander and/or Safety-Communications Officer determines through the use of air monitoring equipment that a decreased level of respiratory protection will not result in hazardous exposures.

f. The level of protection provided by PPE selection shall be increased when additional information on site conditions indicates that increased protection is necessary to reduce employee exposures below permissible exposure limits and published exposure levels for hazardous substances and health hazards.

g. If SCBA or SCAPE-attired personnel are employed in the emergency response, at least one set of backup bottles of breathing air will be maintained at the spill site.

h. If necessary, personnel wearing SCBA may use approved compressed air cylinders from other approved SCBA units for resupply, provided that they are the same capacity and pressure rating.

i. A sufficient number of spill response vehicles, carts and other equipment/materials will be brought to the incident command post area and pre-positioned for DECON and cleanup operations.

j. If special tools or equipment for leak control/repair or spill or wash-down fluid containment are required, they will be requested by the DRF Incident Commander through the command net.

5. Initial Entry Briefing

Prior to entry by any personnel into the immediate release area, the DRF Incident Commander will conduct an initial briefing for both entry and backup team personnel that will include as a minimum:

- Identity of the HAZMAT and any hazardous vapor conditions at the spill release site.
- Potential fire or explosive hazards.
- PPE required.
- Specific tasks to be undertaken and procedures.
- Time limitations for the task/operation.
- Communications methods and frequencies between personnel at the release site and the DRF Incident Commander and Range Safety-Communications Officer
- Emergency withdrawal or rescue signals and procedures.

6. HAZMAT Spill/Release Control and Neutralization

a. The DRF Incident Commander will verify HAZMAT commodity/propellant/HAZMAT flow shutdown or cessation, or use contractor specialized hot zone entry teams to accomplish control and flow termination by valve shutdowns, commodity bypassing or diversion, or by some other technical expert-directed action.

b. Verification of flow termination will be followed by neutralization and/or absorption of the released HAZMAT using applicable materials. The DRF Incident Commander will direct these operations, as follows:

(1) Neutralization and absorption are the render safe (or safer) steps in HAZMAT emergency response that are accomplished by dilution, inerting by addition of other chemicals, absorption and/or physical removal. Materials and techniques for this process are defined on Spill Response Information Cards found inside each Spill Response Cart/Vehicle.

(2) Spill response materials and neutralization and absorption information cards are tailored to the HAZMAT commodities used in the facility/work area where the carts are located.

(3) The USAF or Company Emergency Procedures Document for the specific site/task that resulted in the HAZMAT release condition is: TBD State Title, i.e. - Hazardous Materials (HAZMAT) Incident Emergency Support. This/these documents(s) define appropriate, detailed neutralization, absorption, and decontamination materials and procedures for expected HAZMAT release commodities associated with work task/HAZOPS-directed processing and/or propellant transfer operations.

(4) Where specified by Task Procedures, or Complex/Facility Emergency Procedures Documents, the DRF Incident Commander shall direct the use of vapor suppression or extraction equipment (exhaust fans, scrubbers, foam blankets) to contain or minimize further release of HAZMAT vapors from the release point/equipment.

c. The DRF Incident Commander will consider runoff from dilution or neutralization operations, particularly if water is used. Runoff will be controlled by commercial dikes or, if outside, by interceptor ditches or dikes prepared by heavy equipment forces. Soil or other loose materials exposed to contaminated runoff will be collected and containerized as hazardous waste.

7. Decontamination and Cleanup

Decontamination and cleanup operations can be as equally hazardous as release identification and termination tasks. The DRF Incident Commander must insure compliant PPE is worn by participants in all phases of employee contact with the HAZMAT chemical in its residual form and with contaminated soil, water, and diking/containment items and absorbents used at the incident site.

a. Decontamination (Decon) is the process to remove or neutralize contaminant residues from the spill site, and on equipment, PPE and personnel exposed during HAZMAT emergency response to prevent adverse health or material degradation effects after the emergency is terminated.

b. Possible Decon methods include absorption, chemical degradation, dilution, off-gassing and neutralization.

c. Specific Decon methods and materials are defined by the properties and state (solids, liquids and vapors) of the HAZMAT commodity that comes in contact with the material to be decontaminated.

d. Decon materials and application information cards are located in Spill Response Carts/Vehicles, and are tailored to the HAZMAT commodities used in the facility/work area where the carts are located.

e. The DRF Incident Commander shall ensure that decontamination operations are conducted only by DRF personnel trained to the 29 CFR 1910.120 (q) HAZMAT Technician level, and have completed emergency response training specified for team members in the CCAS HAZMAT Emergency Response Plan.

f. Prior to the initiation of decon operations, the DRF Range Safety-Communications Officer will determine hazardous vapor threat levels, if any, by use of air monitoring equipment. The DRF Incident Commander will then specify PPE to be used during decon, based on the hazards and HAZMAT identified in the decon area.

g. A decontamination initial briefing shall be conducted by the DRF Incident Commander and Safety-Communications Officer and shall include specific work procedures, materials and safety considerations previously identified for containment and neutralization operations.

h. All decon and cleanup equipment shall be in serviceable condition and inspected prior to use.

i. The DRF Incident Commander will consider runoff from Decon dilution or neutralization operations, particularly if water is used. Runoff will be controlled by Spill Response Cart dikes or, if outside, by interceptor ditches or dikes. Soil or other loose materials exposed to contaminated runoff will be collected and containerized as hazardous waste.

8. Termination

a. The DRF Incident Commander will collect relevant data regarding the incident response from all personnel involved in the operation to document lessons learned, hazards encountered, what worked and what did not, and estimated employee exposures to hazardous chemicals and vapors.

(1) This information will be posted on a formal written record (HAZMAT Emergency Response Termination Report), and will be completed before the DRF Incident Commander leaves the incident site. Required Termination Report forms and data requirements are included in the DRF On-Scene Command Post vehicle.

(2) Termination Reports will be used by the DRF Incident Commander to prepare a formal emergency response critique, as required by OSHA and the CCAS HAZMAT Emergency Response Plan.

b. The DRF Incident Commander will inform all personnel involved in the response operation of potential exposures to hazardous materials/vapors and the signs and symptoms associated with that exposure. Personnel will be directed to report to the medical facility, if such symptoms are experienced after personnel are released from response duties.

c. The DRF Incident Commander will identify any PPE or other equipment damage and initiate proper remedial action.

d. The DRF Incident Commander will direct the inventory of remaining Spill Response Cart/Vehicle materials and equipment, and the requirement to requisition replacements.

9. Notification of Termination

The DRF Incident Commander will notify the CCAS/45th SPW command net that decon and cleanup operations are complete and that PPE and emergency materials and equipment are cleaned, restocked and fit for intended use prior to the resumption of normal launch complex/facility processing or support operations.

ANNEX 7 - 29 CFR 1910.120 CATEGORIES OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

1. Level A - To be selected when the greatest level of skin, respiratory and eye protection is required.

- Positive pressure, full face piece SCBA, or positive pressure supplied respirator with escape SCBA (both NIOSH-approved).
- Totally-encapsulating chemical-protective suit.
- Coveralls & long underwear.
- Outer & inner chemical-resistant gloves
- Chemical-resistant steel toe & shank boots & hard hat.
- Disposable protective suit, gloves and boots - may be worn over totally-encapsulating suit.

2. Level B - The highest level of respiratory protection is required, but a lesser level of skin protection is needed.

- Positive pressure, full face piece SCBA, or positive pressure supplied respirator with escape SCBA (both NIOSH-approved).
- Hooded chemical resistant clothing (coveralls and long-sleeved jacket; coveralls; one or two-piece chemical splash suit; disposable chemical-resistant overalls).
- Coveralls (Optional).
- Outer & inner chemical-resistant gloves
- Chemical-resistant steel toe & shank boots & boot covers, plus hard hat.
- Face shield (Optional).

3. Level C - The concentrations and types of airborne substances are known and the criteria for using air purifying respirators are met.

- Full-face or half mask, air purifying respirators (NIOSH approved).
- Hooded chemical-resistant clothing (coveralls; two-piece chemical-splash suit; disposable chemical-resistant overalls)
- Coveralls (Optional).
- Outer & inner chemical-resistant gloves
- Chemical-resistant steel toe & shank boots & boot covers, plus hard hat.
- Escape mask (Optional)
- Face shield (Optional).

4. Level D - A work uniform affording minimal protection. Used for nuisance contamination, only.

- Coveralls.
- Chemical-resistant steel toe & shank boots & boot covers.
- Safety glasses or chemical splash goggles.
- Optional items: Gloves, hard hat, escape mask & face shield.

APPENDIX H

CAPE CANAVERAL AIR STATION HYPERGOLIC PROPELLANT FLOW CHARTS

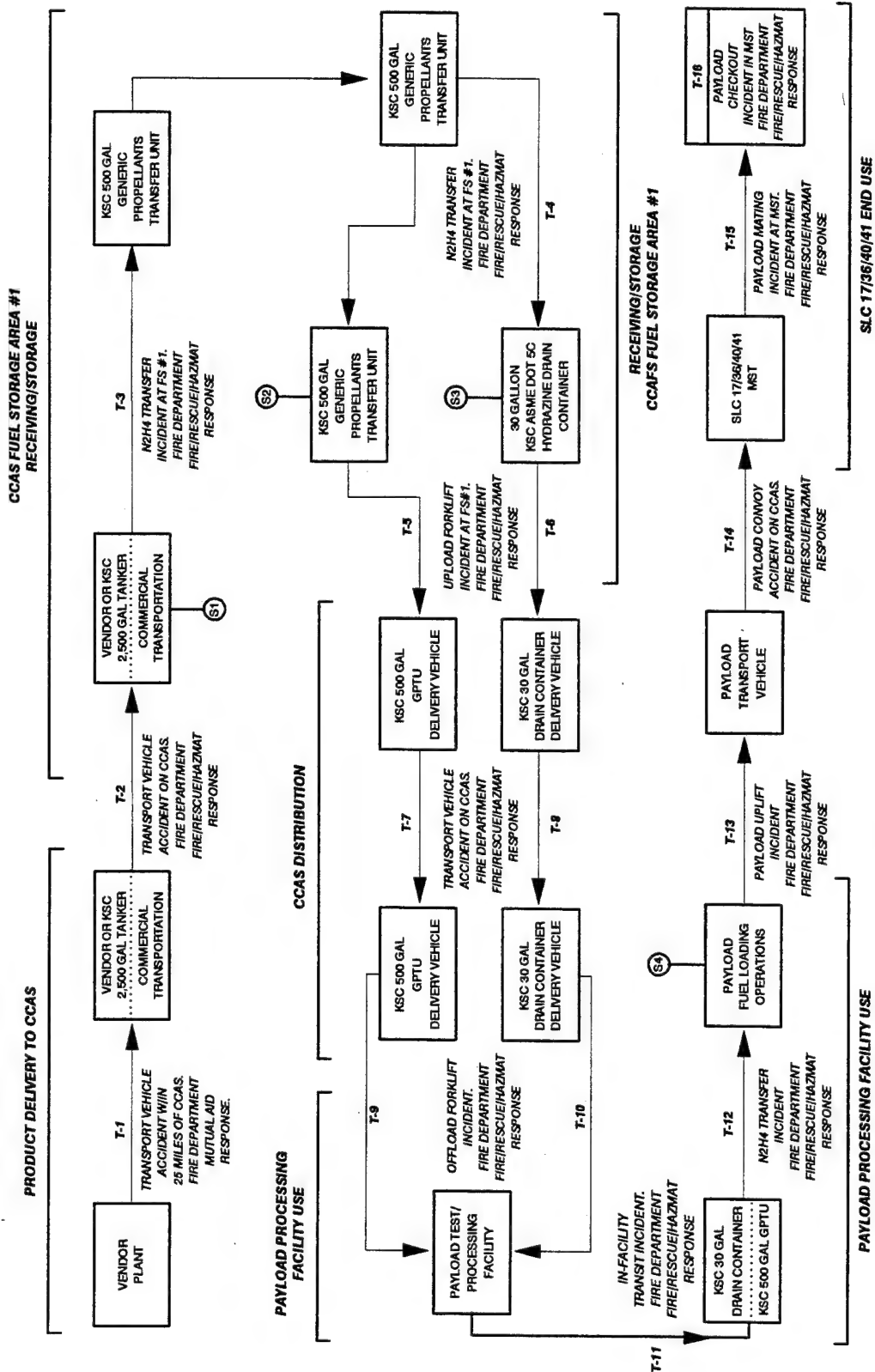


Figure H-1. High-Purity Hydrazine Hazard Flow Chart:
Tanker-Sourced 30- & 500- Gallon
Containers (Payload Processing Facilities)

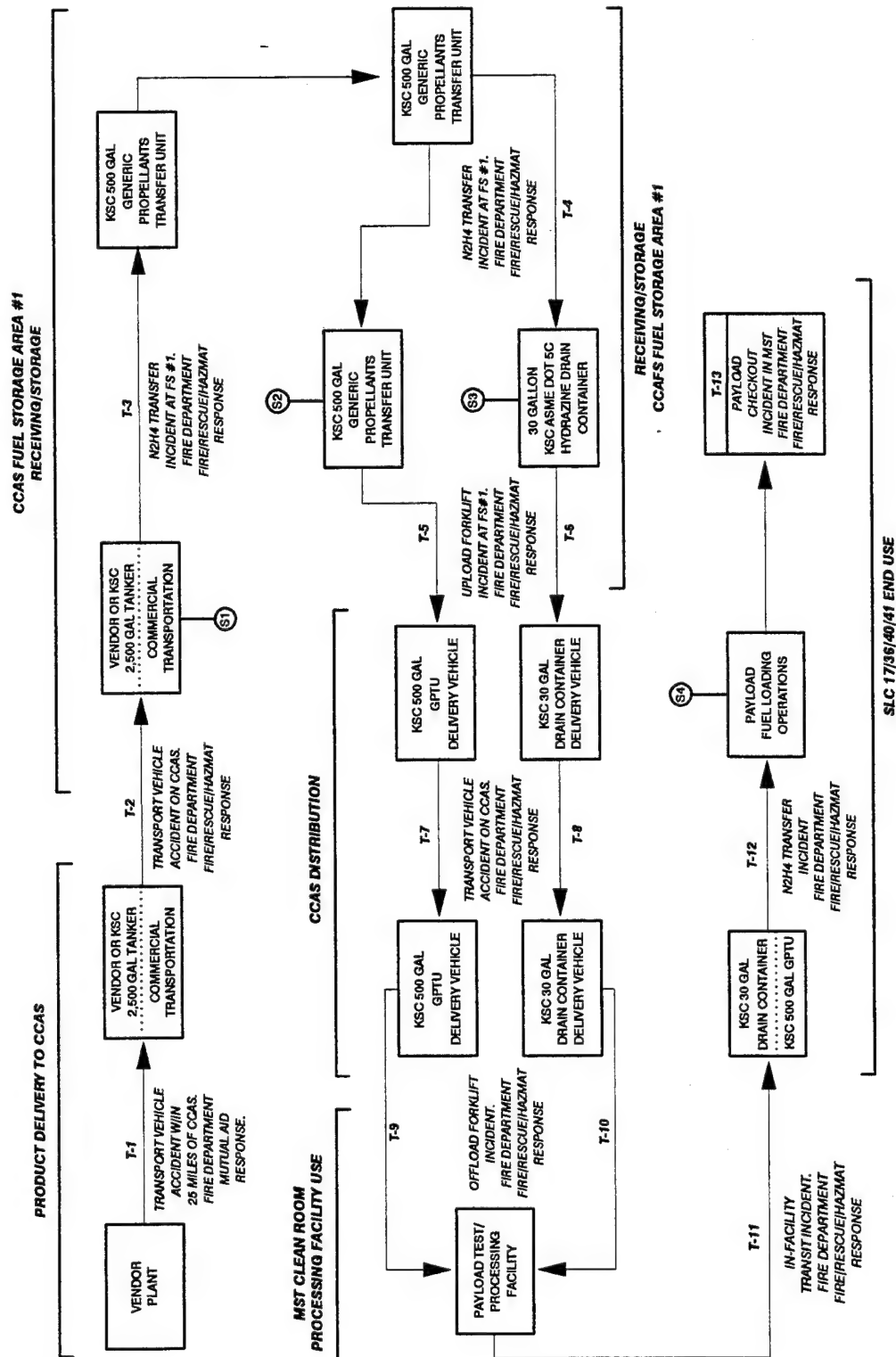


Figure H-2. High-Purity Hydrazine Hazard Flow Chart:
Tanker-Sourced 30- & 500- Gallon Containers
(MST Clean Room Payload Processing Facilities)

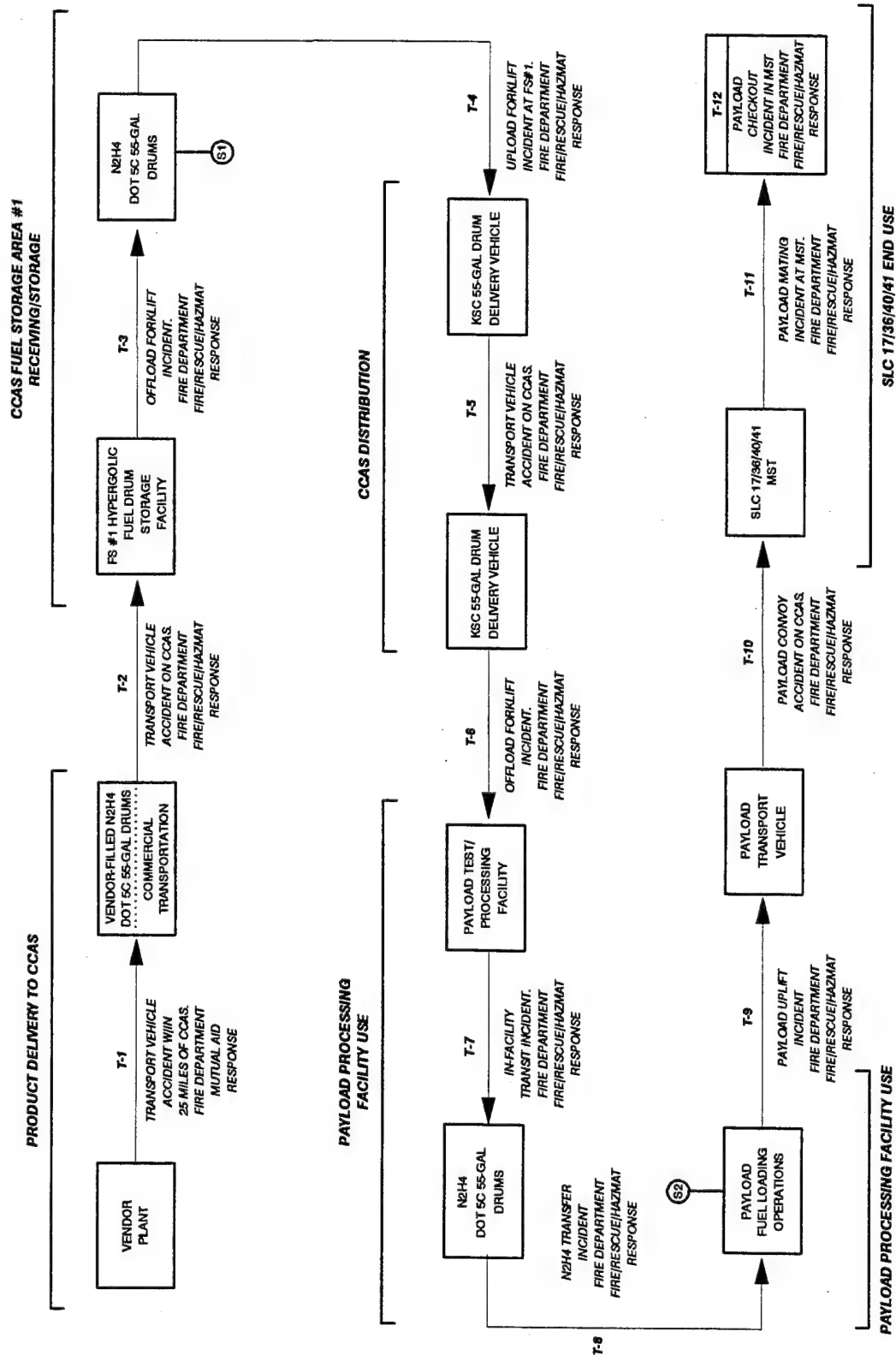


Figure H-3. High-Purity Hydrazine Hazard Flow Chart:
55-Gallon Drums (Payload Processing
Facilities)

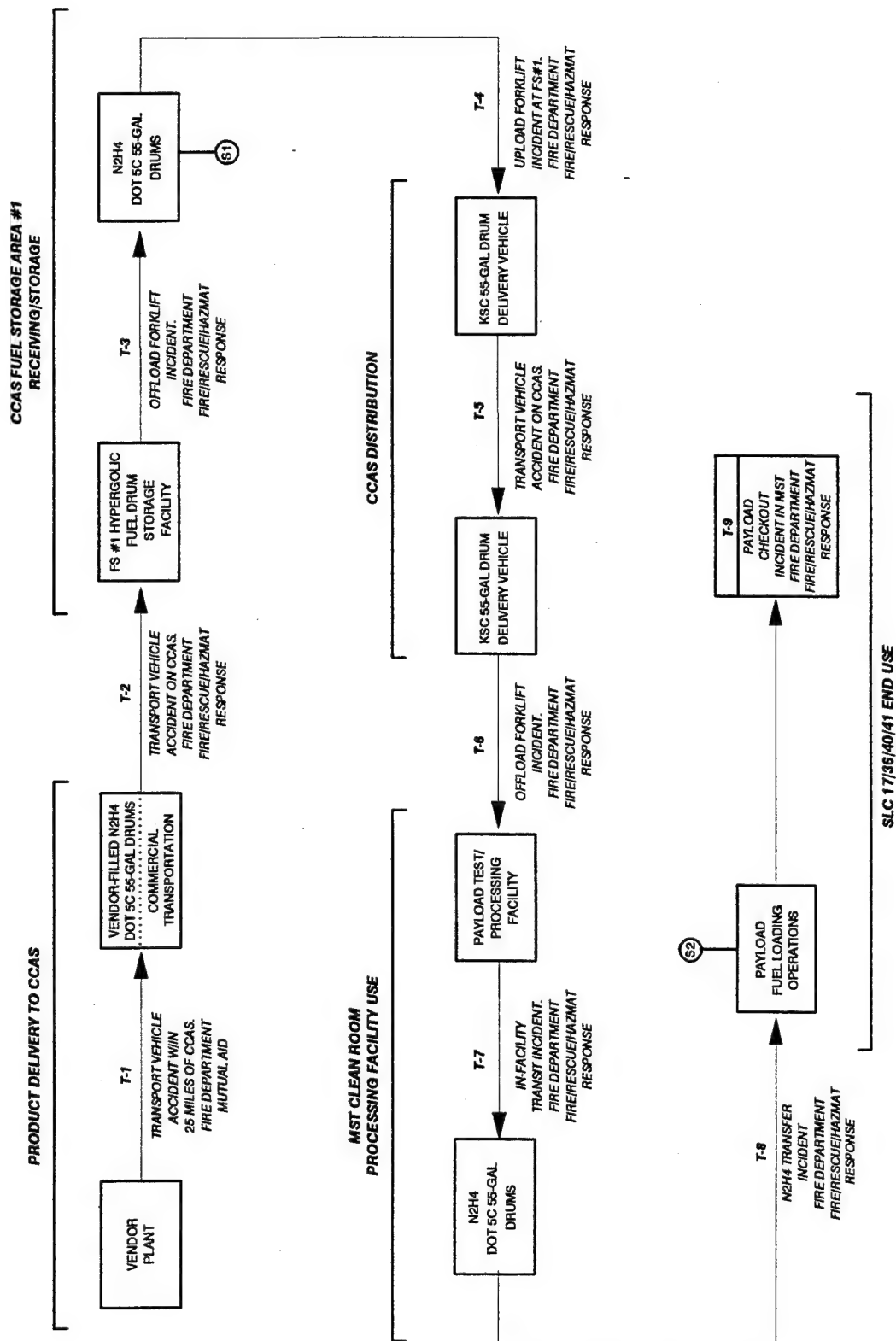


Figure H-4. High-Purity Hydrazine Hazard Flow Chart: 55-Gallon Drums (MST Clean Room Payload Processing Facilities)

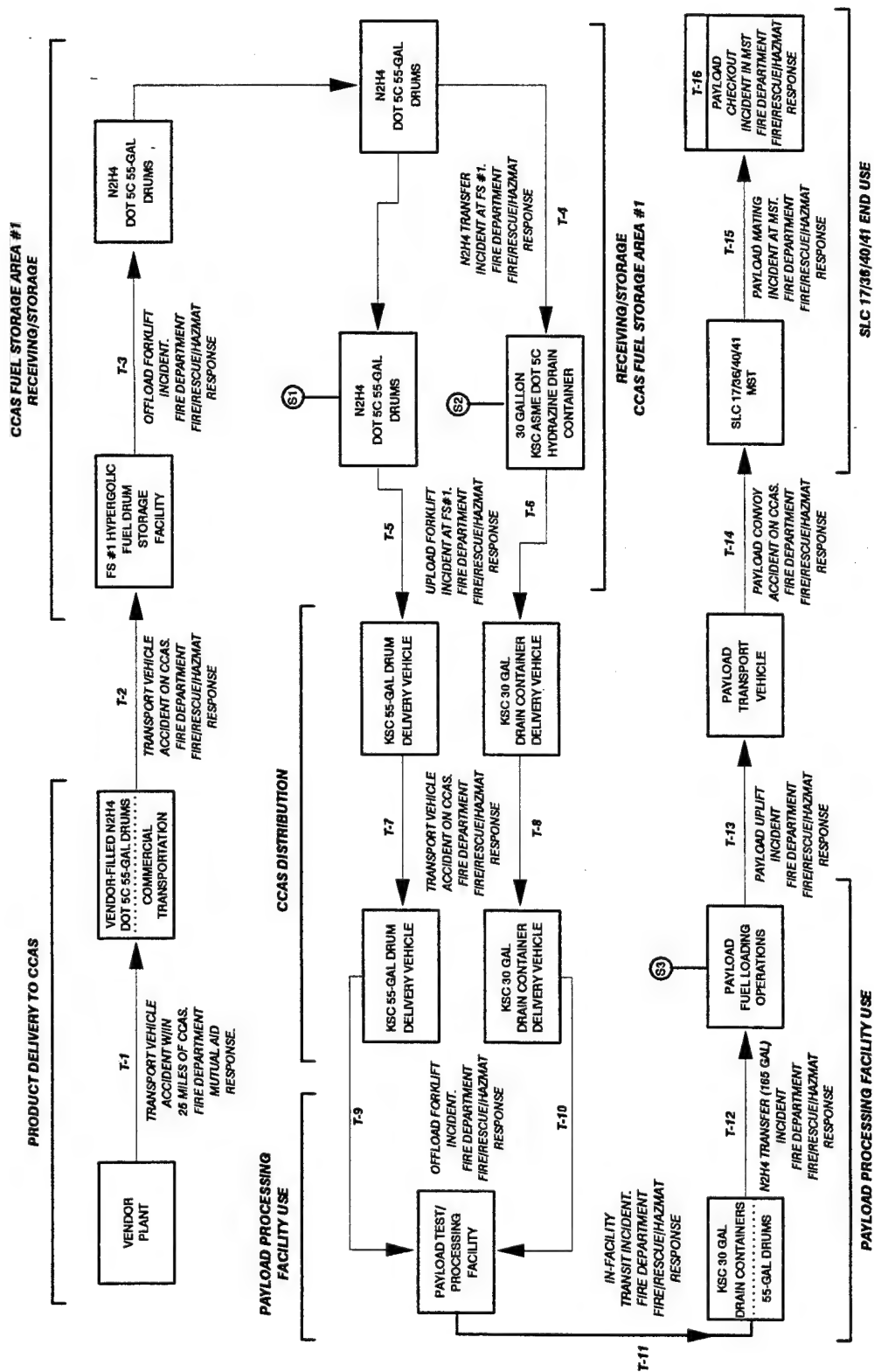


Figure H-5. Monopropellant-Grade Hydrazine Hazard Flow Chart: 55-Gallon Drums & 30-Gallon Containers (Payload Processing Facilities)

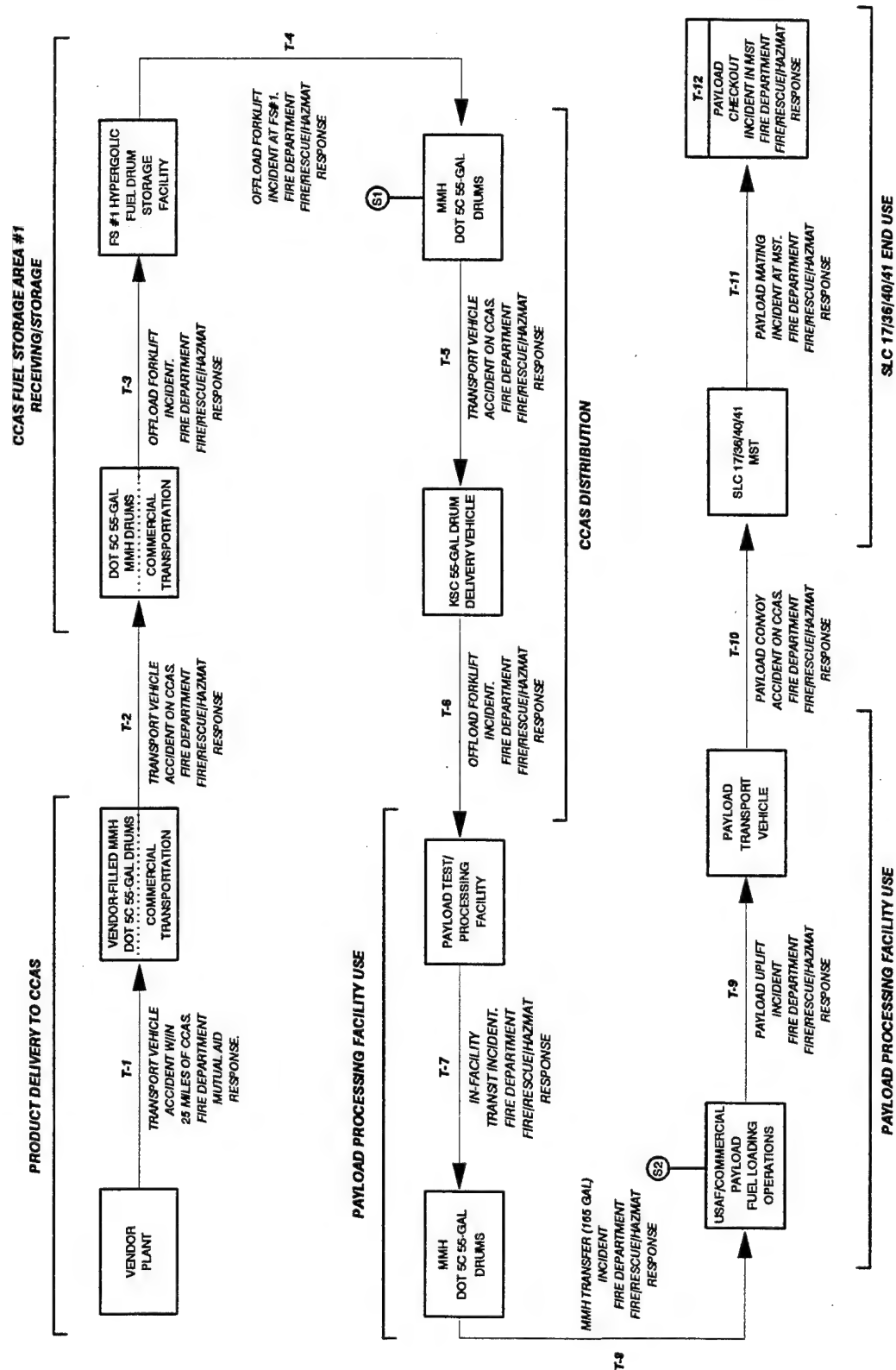


Figure H-6. Monomethylhydrazine (MMH) Hazard Flow Chart: 55-Gallon Drums (Payload Processing Facilities)

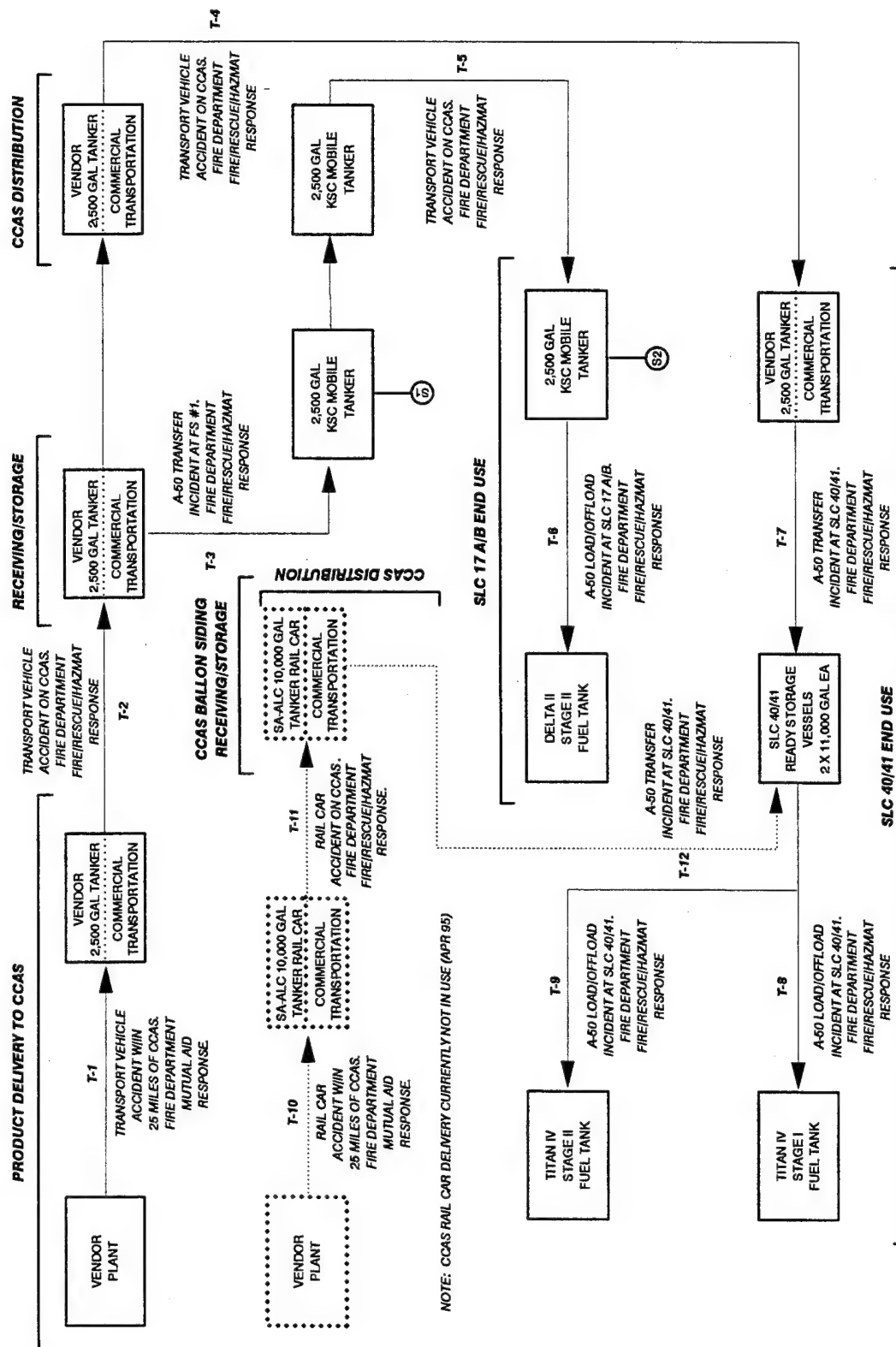


Figure H-7. Aerozine-50 (A-50) Hazard Flow Chart

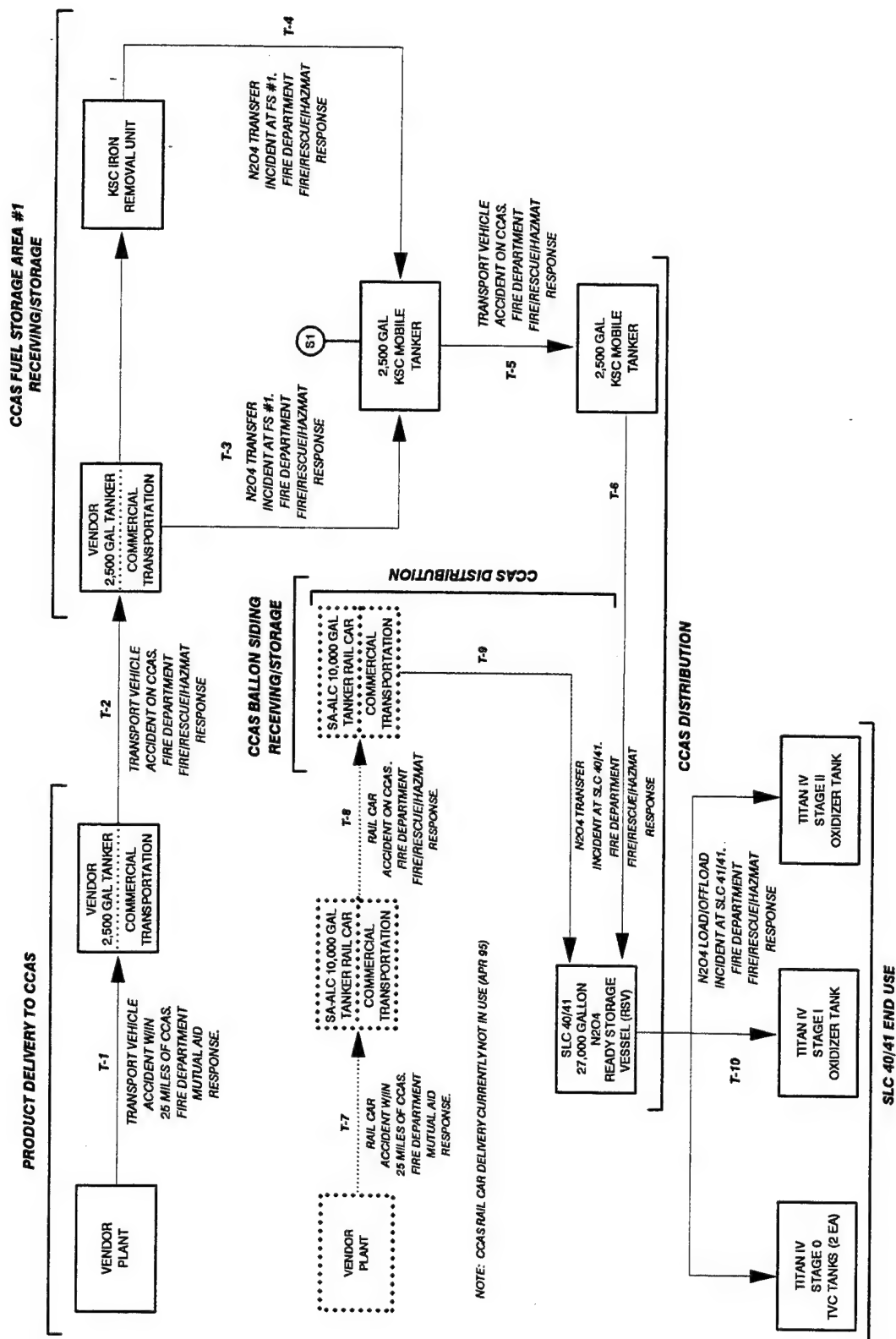


Figure H-8. Normal Grade Nitrogen Tetroxide Hazard Flow Chart (Titan IV Launch Site)

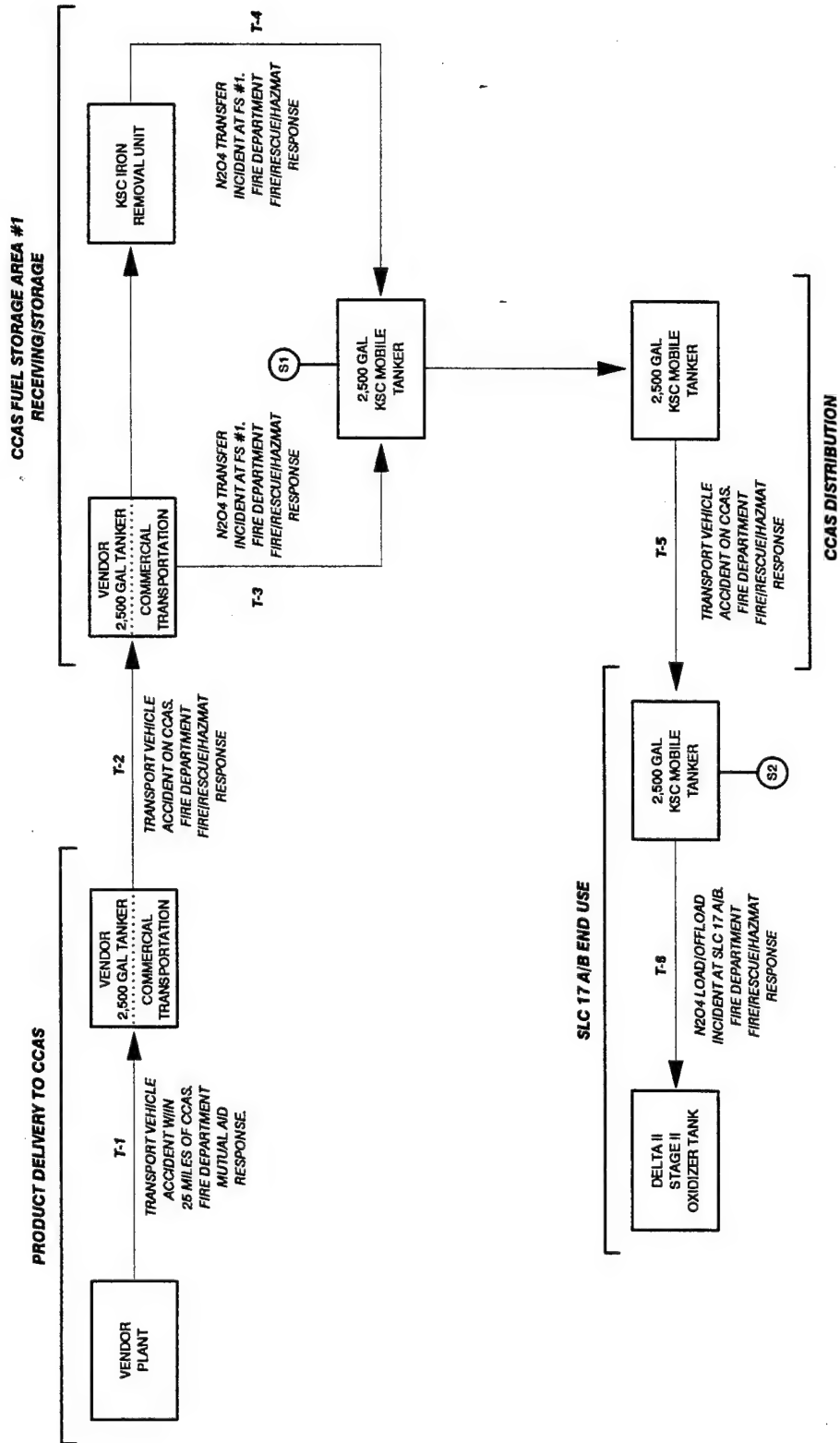


Figure H-9. Low Iron-Mon 1 Nitrogen Tetroxide Hazard Flow Chart (Delta IV Launch Site)

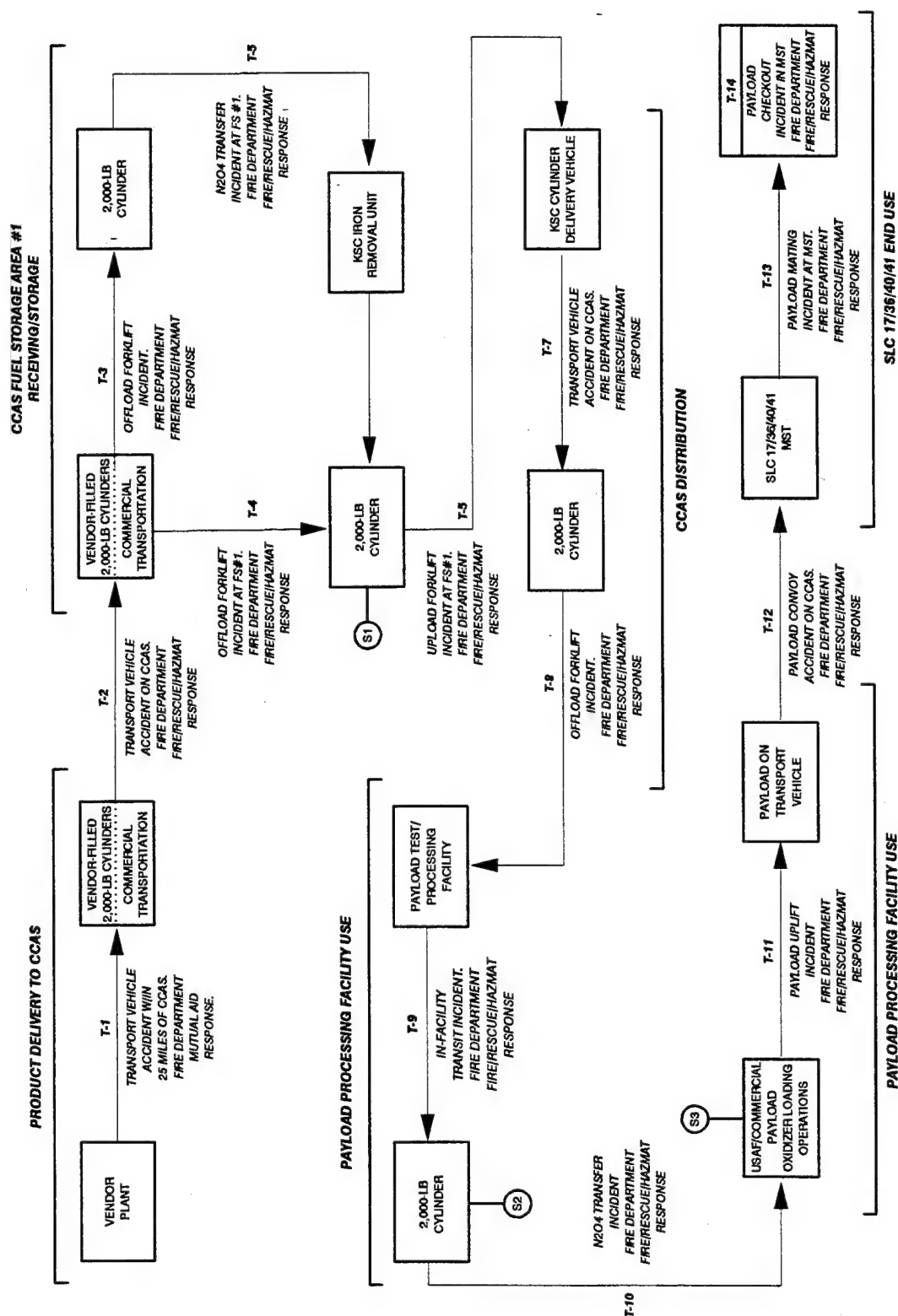
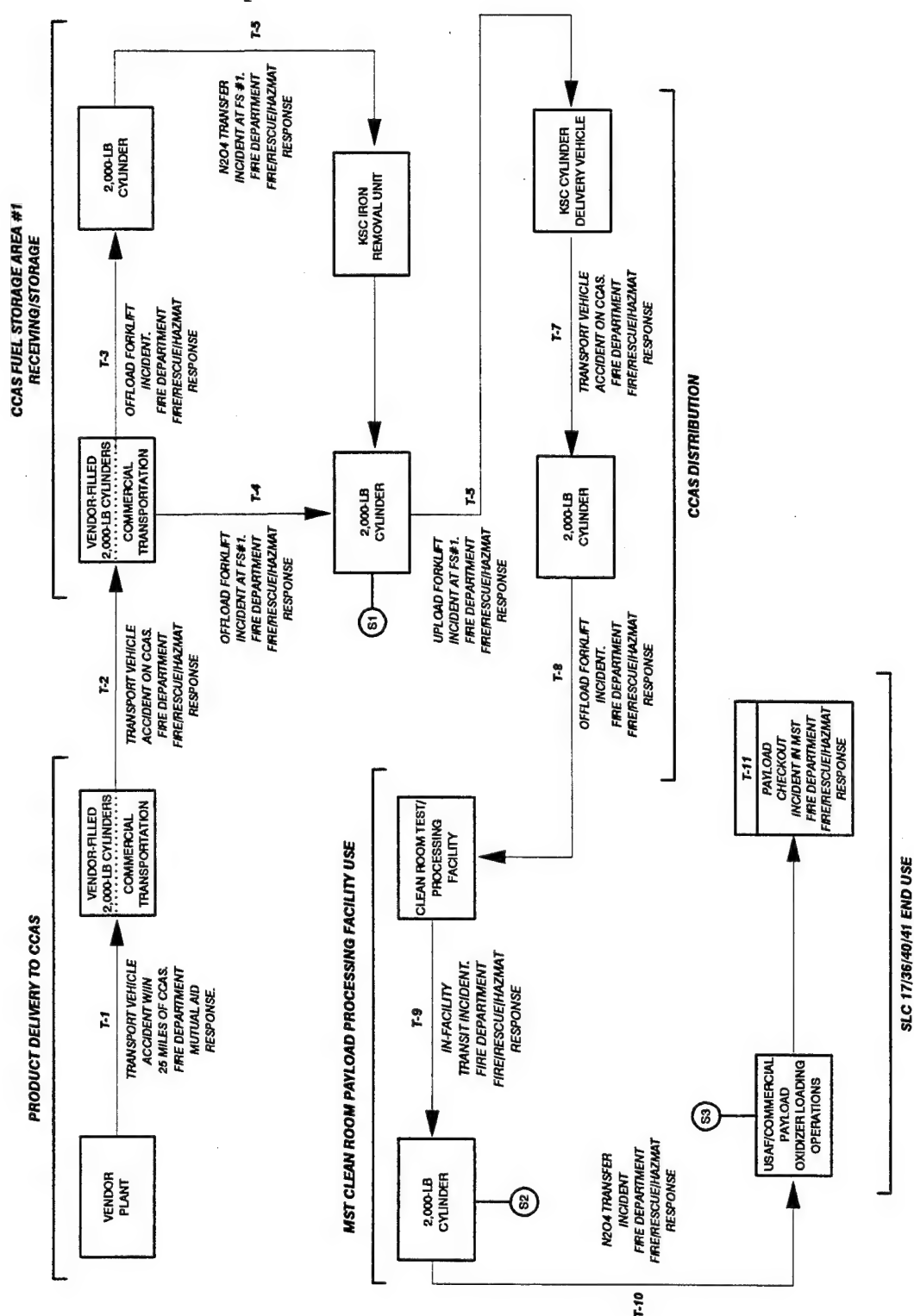


Figure H-10. Low Iron-Mon 1, Mon 3 & Mon 10 Nitrogen Tetroxide Hazard Flow Chart (Payload Processing Facilities)



APPENDIX I

VANDENBERG AIR FORCE BASE HYPERGOLIC PROPELLANT FLOW CHARTS

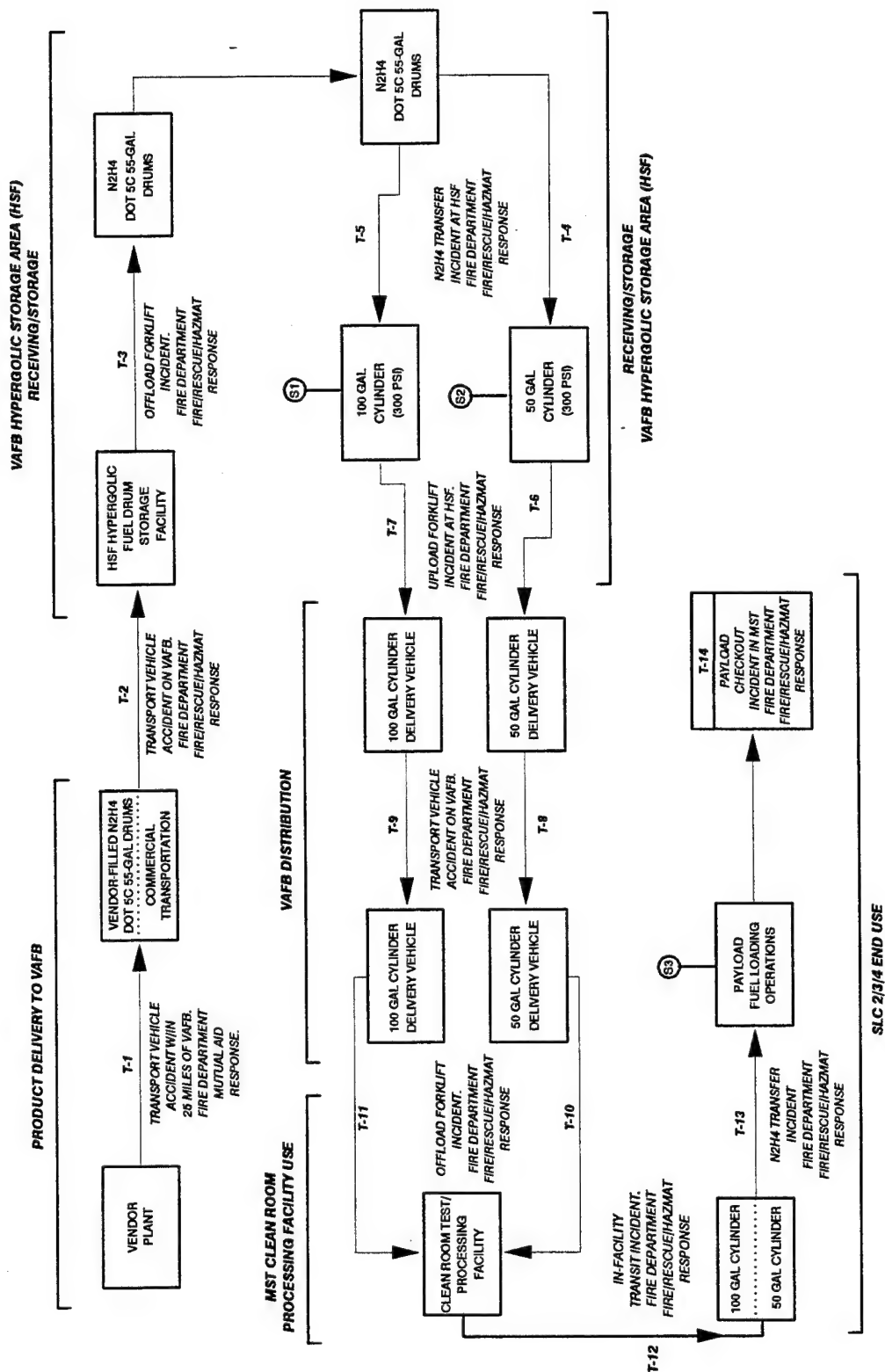


Figure I-2. High-Purity Hydrazine, Monopropellant Grade Hydrazine & Monomethylhydrazine (MMH) Hazard Flow Chart: 55-Gallon Drum-Sourced 100- & 50- Gallon Cylinders (MST Clean Room Payload Processing Facilities)

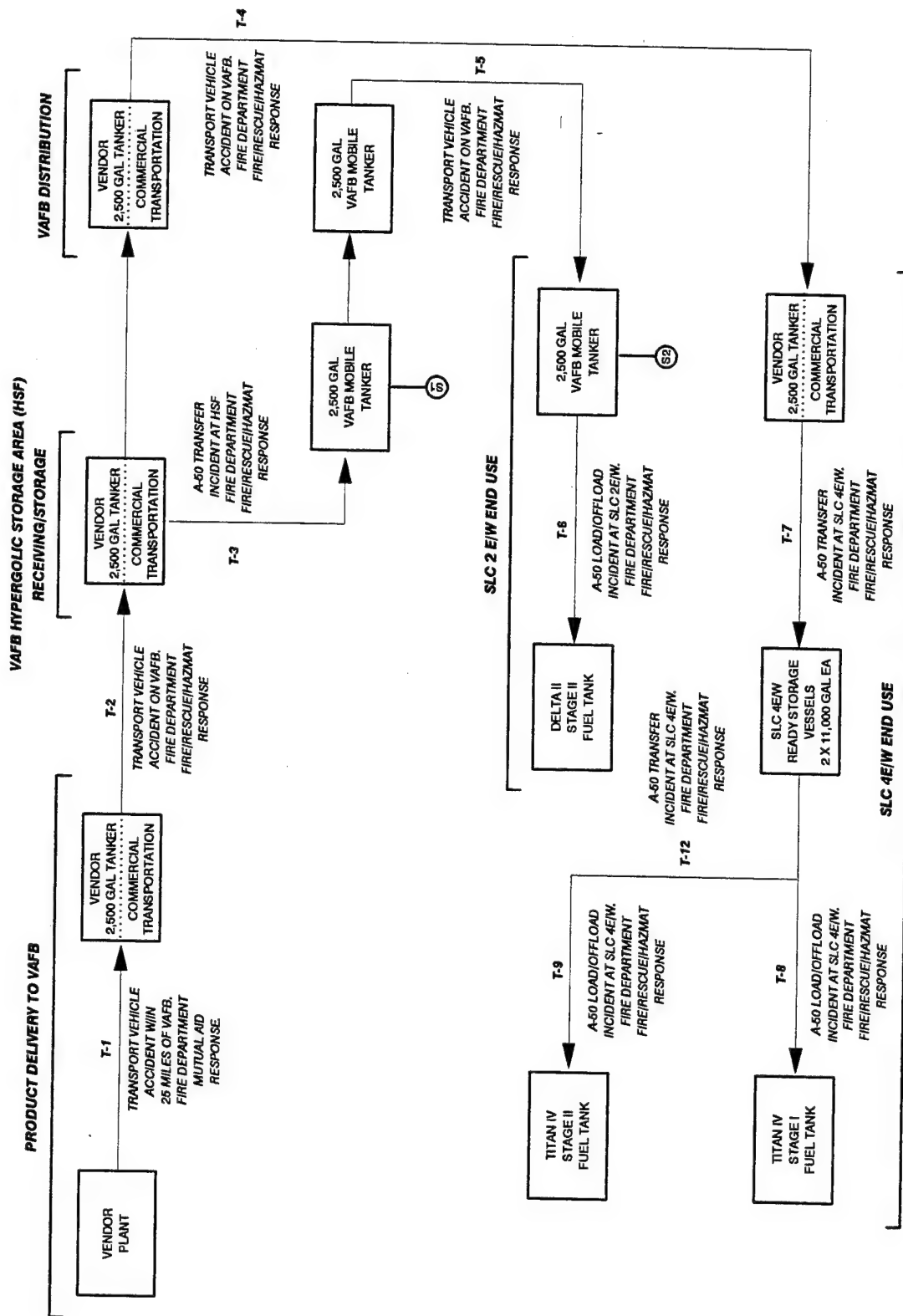


Figure I-3. Aerozine-50 (A-50) Hazard Flow Chart

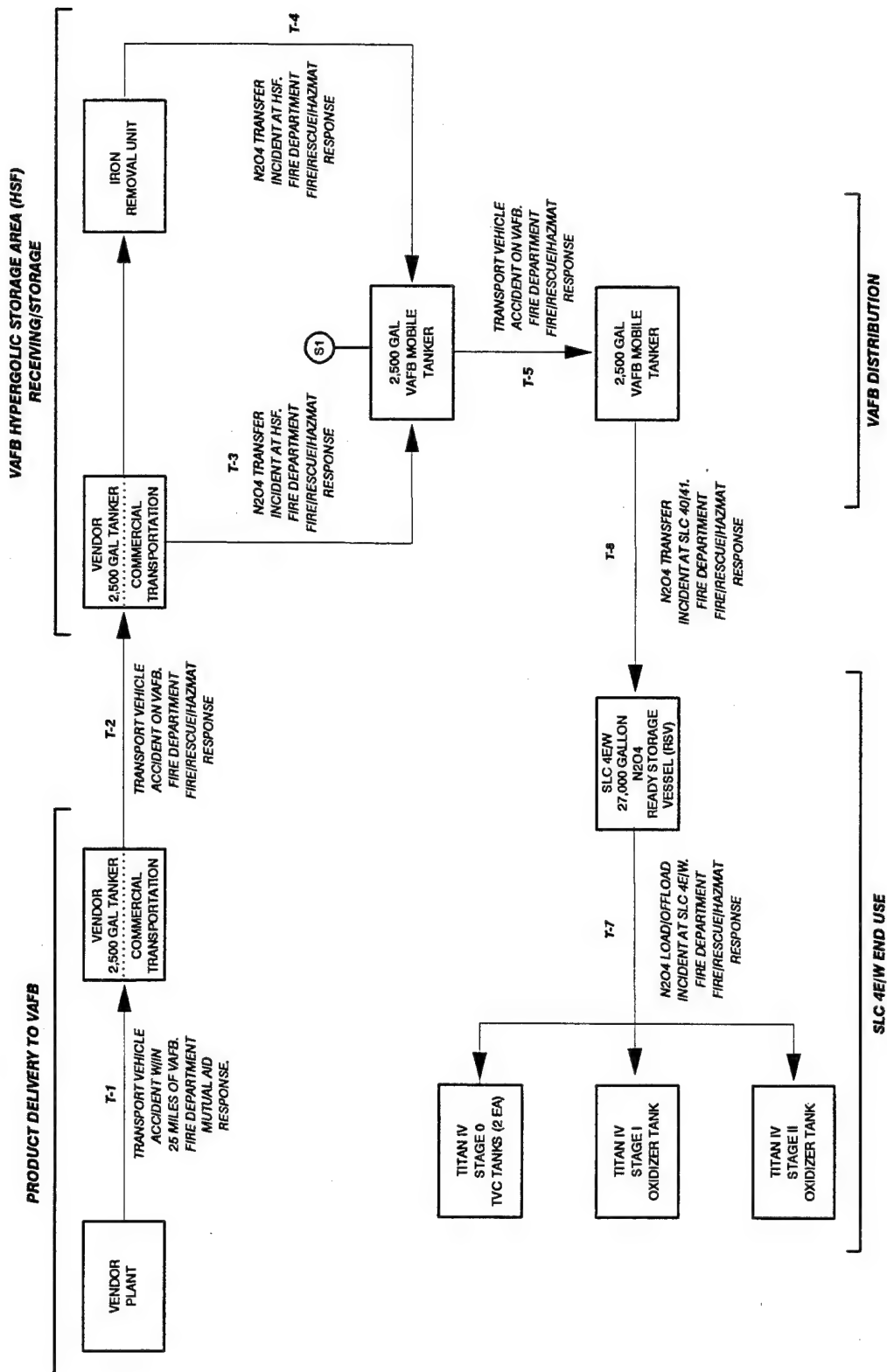


Figure I-4. Normal Grade Nitrogen Tetroxide Hazard Flow Chart (Titan IV Launch Site)

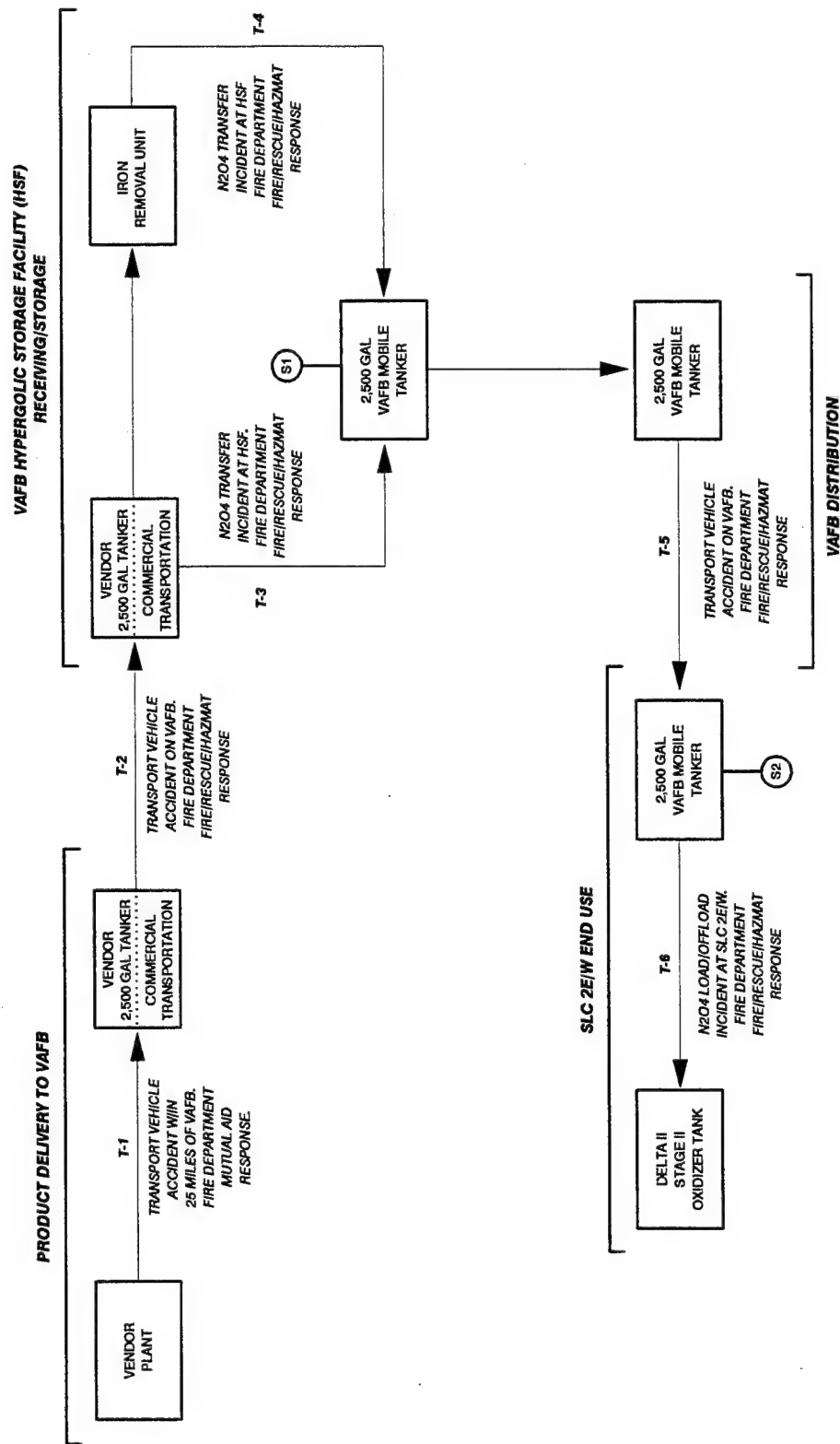


Figure I-5. Low Iron-Mon 1 Nitrogen Tetroxide Hazard Flow Chart (Delta IV Launch Site)

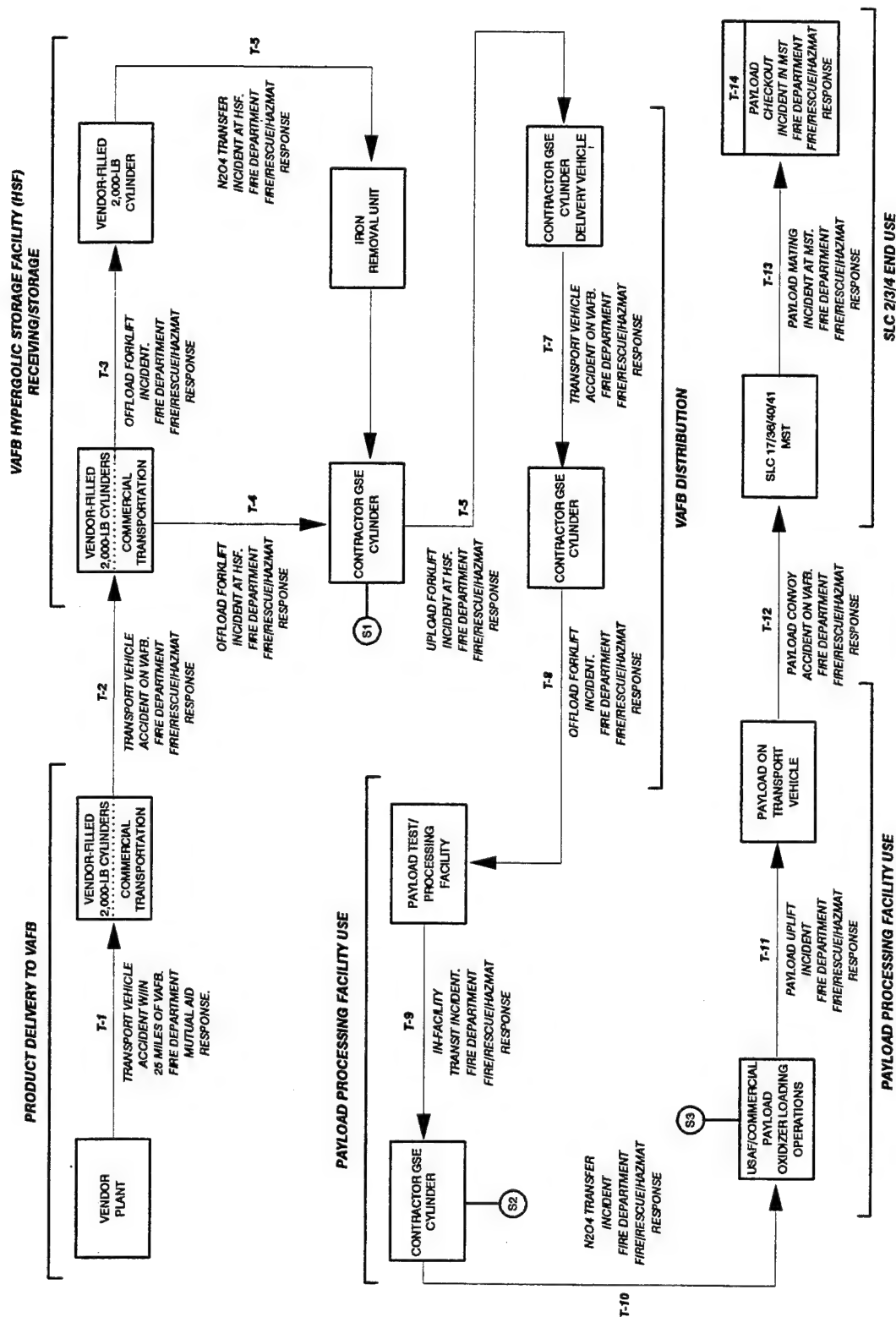


Figure I-6. Low Iron-Mon 1, Mon 3 & Mon 10 Nitrogen Tetroxide Hazard Flow Chart (Payload Processing Facilities)

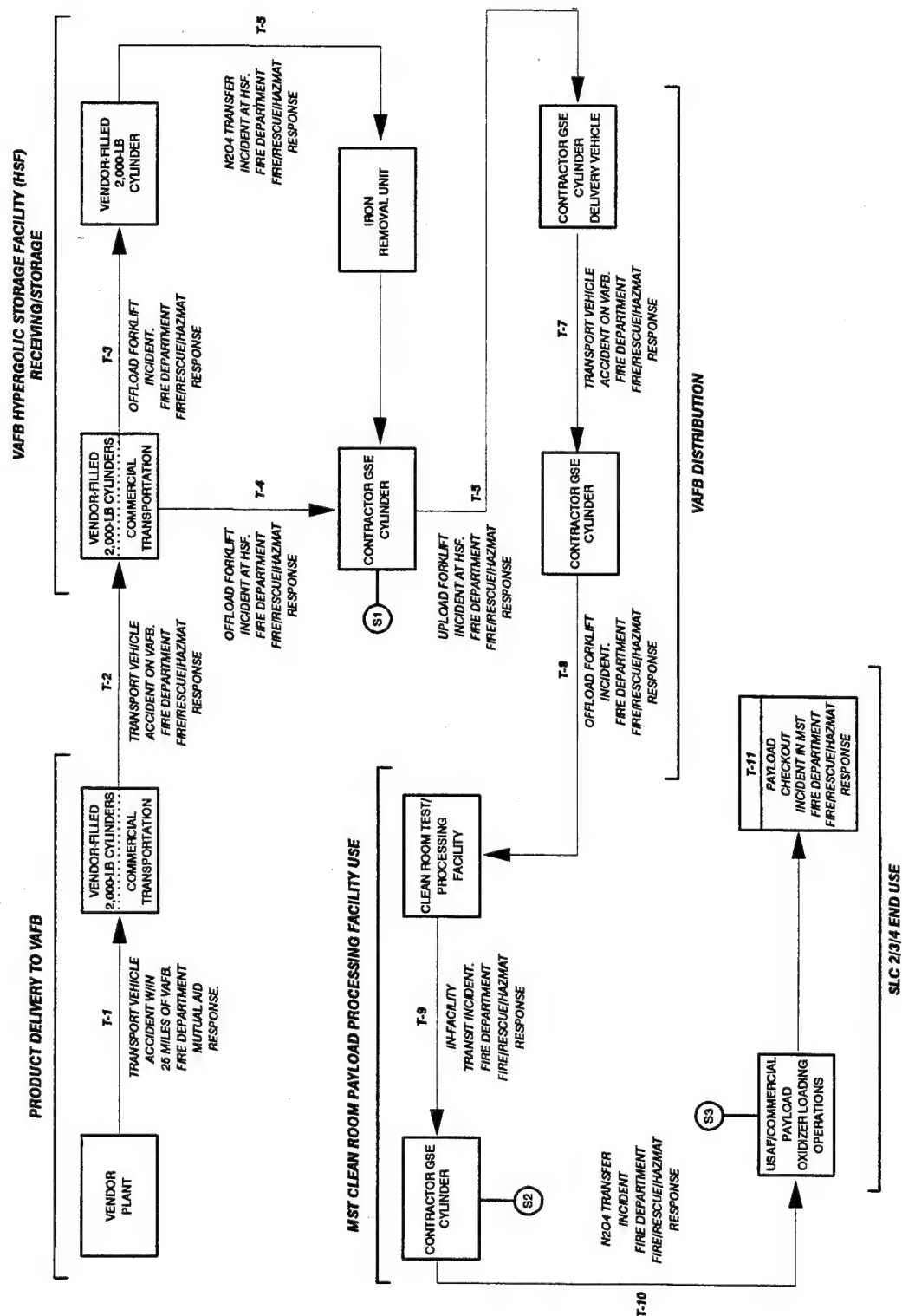
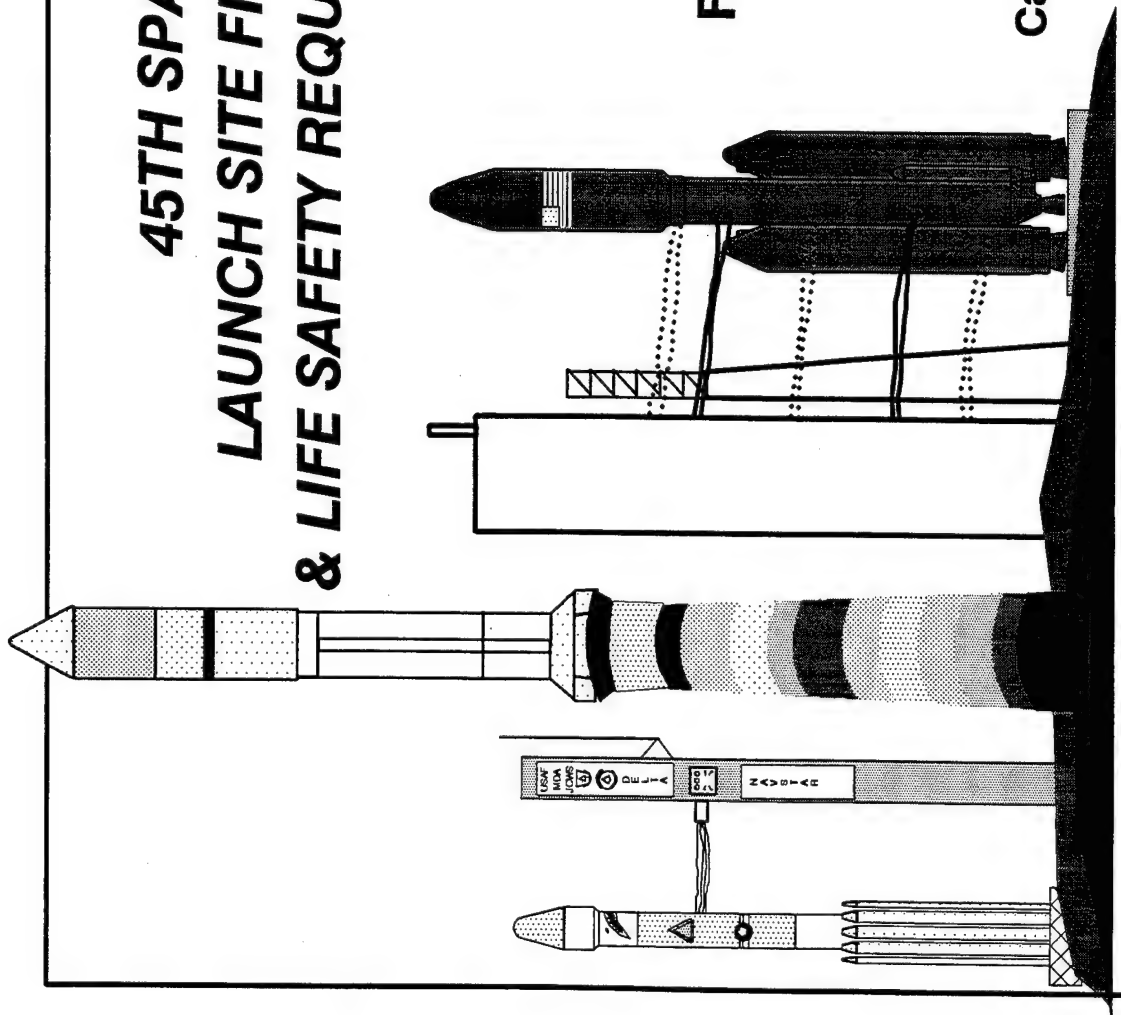


Figure I-7. Low-Iron Mon 1, Mon 3 & Mon 10 Nitrogen Tetroxide Hazard Flow Chart (Payload Processing Facilities)

APPENDIX J

**BRIEFING PACKAGE: 45TH SPACE WING LAUNCH SITE FIRE
PROTECTION & LIFE SAFETY REQUIREMENTS ANALYSIS**

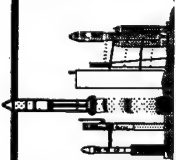


**45TH SPACE WING
LAUNCH SITE FIRE PROTECTION
& LIFE SAFETY REQUIREMENTS ANALYSIS**

**45 CES/CEF
Fire Protection Office**

Cape Canaveral Air Station, FL

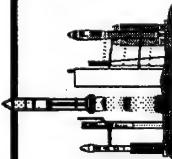
45THRT1



45th SPW Launch Site Fire Protection Requirements Analysis

AGENDA

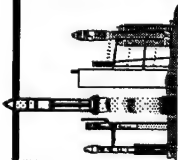
- OBJECTIVES
- SITUATION
- USAF-CONTRACTOR RESPONSIBILITIES
- ANALYSIS PROCESS
- ANALYSIS TEAM APPROACH
- ANALYSIS BASELINE STRAWMAN
- WHICH STANDARDS APPLY?
- RECAP
- BREAK
- SLS/CEF ACTION ITEMS
- REQUIRED STANDARDS STRAWMAN
- STANDARDS COMPENDIUM (SEPARATE COVER)



45th SPW Launch Site Fire Protection Requirements Analysis

OBJECTIVES

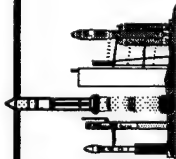
- Identify Facility, Installed/Portable System & Procedural Upgrades/Improvements Required At SLS Launch Site and Payload Processing Facility Workplaces To Enable Compliance With USAF & OSHA Fire Protection, Life Safety and HAZMAT Spill/Release Response Standards.
- Ensure CCAS Commanders And Contractor Executives Are Aware of Mandatory (Law) OSHA Requirements To Properly Train And Equip Employees For The Safe Response To Incidental Releases And Emergencies Involving Hazardous Chemicals And Fires At SLS Launch Sites And Payload Processing Facilities.
- Prevent Civil (& Possibly, Criminal) Liability Legal Judgements Against CCAS Military & Contractor Supervisors/Commanders/Executives In The Event Of A Personal Injury/Death Law Suit Involving An Accidental Harardous Chemical Release Or Fire Incident At A Launch Site Or Other Processing Facility.
- Provide An Audit Trail Of Risk Assessment Analyses & Engineering Decisions Regarding the Development & Approval of 45 SPW Fire Protection, Life Safety & HAZMAT Response Policy/Directives For Launch Tower/Processing Facilities.



45th SPW Launch Site Fire Protection Requirements Analysis

OBJECTIVES (ADDED)

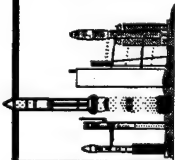
- Identify Commander's Responsibilities Associated With The OSHA Standard on Process Safety Management Of Highly Hazardous Chemicals (29 CFR 1910.119)



45th SPW Launch Site Fire Protection Requirements Analysis

SITUATION

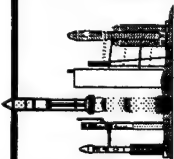
- There are no specific National, DOD or USAF Fire Protection & Life Safety standards for launch tower & ground level payload processing clean room facilities. This makes assessment/self-assessment difficult.
- CCAS operational Launch Complexes 17, 36 & 40/41 were constructed at different times to different Fire Protection & Life Safety Criteria. Each has different clean room configurations & payload processing procedures. Each will require a different degree of upgrade for compliance w/standards.
- 45 CES/CEF Is Not Aware Of Published SLS & SLS Contractor Policies/Training IAW OSHA standards for employee response to hazardous chemical incidental & emergency response releases (29 CFR 1910.1200 & 1910.120(q)). These must be adopted by launch site/tower & clean room users and be consistent with the roles and responsibilities of the fire department's rescue & HAZMAT emergency response roles & missions. Company policies, plans & procedures must be documented & trained, to include Medical Surveillance & PPE O&M.



45th SPW Launch Site Fire Protection Requirements Analysis

SITUATION (CONTINUED)

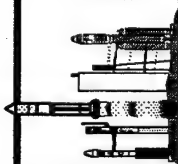
- OSHA 29 CFR 1910.119 Requires CCAS Employers to Establish & Maintain A Process Safety Management (PSM) Program That Prevents Or Minimizes The Consequences Of Catastrophic Releases Of Toxic, Reactive, Flammable Or Explosive Chemicals. Consistent Implementation to the OSHA Standard By Each CCAS SLS & Support Contractor Is TBD.
- OSHA 29 CFR 1910.119 Requires CCAS Employers to Establish & Maintain Emergency Action Plans For All Facilities, Procedures For Handling Small Releases, and HAZMAT Emergency Response Plans IAW 29 CFR 1910.38 (a) & 29 CFR 1910.120 (q)



45th SPW Launch Site Fire Protection Requirements Analysis

SITUATION (CONTINUED)

- HQ AFSPC/SE/CE Ltr, 12 May 94, Subj: Interim Policy For Fire Suppression Systems In Launch Tower Satellite Clean Rooms, Requires The Following:
 - Launch Tower FSS Valves Locked/Tagged Closed, Except During Dynamic Propellant Transfer When Valves Are To Be Manned For Activation To Minimize Launch Vehicle & Facility Loss. Activation ONLY AFTER The Payload Has Been Destroyed
 - Users To Develop Hypergol Spill/Fire Immediate Response Procedures
 - Coordinated Safety/Fire/User/Biomedical Emergency Response Training
 - Launch Complex Compliance With Life Safety Code Protected Egress Requirements
 - Implementation By 45 SPW Policy Ltr:
 - Specific Guidance For Each Pad
 - Revise Range Safety Regs To Reflect Policy
- We Have Developed A Requirements Analysis Process To Facilitate Compliance With This AFSPC Requirement & To Ensure All Parties Comply With Mandatory Federal Worker Safety Standards.



45th SPW Launch Site Fire Protection Requirements Analysis

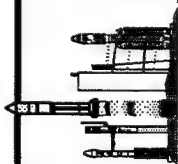
OSHA/AFOSH OCCUPATIONAL SAFETY & HEALTH STANDARDS Generalized USAF - Government Contractor Responsibilities For Fire Protection & Life Safety

CCAS Facility Owner-User (USAF Commanders & Supervisors)

- Provide A Workplace In Compliance w/OSHA, DOD & USAF Standards
- Provide Resources For Fully Compliant Procedures, Facilities & Installed Systems & For Correcting Deficiencies
- Operate & Maintain (Or Provide For O&M) Of Installed Systems Per Standards
- Maintain Compliant Workplace Safety Policy & Procedures, Enforcement & Training
- Conduct Operations IAW OSHA/AFOSH Standards
- Maintain Cognizance Of & Properly Use Installed Fire/Vapor Protection & Life Life Safety Systems
- Use/Maintain Installed Systems Per Standards

CCAS Facility Users Other Than USAF (Contractor Executives & Supervisors)

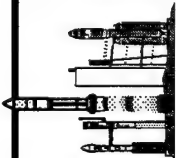
- Insure Fully-Compliant, Safe Workplaces
- Maintain Compliant Workplace Safety Policy & Procedures, Enforcement & Training
- Conduct Operations IAW OSHA/AFOSH Standards
- Maintain Cognizance Of & Properly Use Installed Fire/Vapor Protection & Life Life Safety Systems
- Use/Maintain Installed Systems Per Standards



45th SPW Launch Site Fire Protection Requirements Analysis

ANALYSIS PROCESS

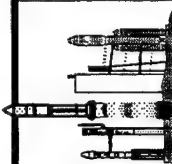
- Fire Department/User/Safety Teams Establish Existing Facility Baselines, Identify HAZOPS Parameters And Conduct SLS Hazard Analyses.
 - Launch Sites
 - Non-SLC Processing/Support Facilities
- Fire Department/Safety/SLS Teams Determine Which Standards Apply To Each Facility, Highly Hazardous Process & Potential HAZOP Emergency To Ensure Process & Worker Safety Are Fully Considered & Risks Are Minimized
- Fire Department/Safety/SLS Teams Determine Facility Modifications Required For Compliance w/Life Safety Standards
- Fire Department/Safety/SLS Teams Determine HAZMAT Emergency Response Planning/Training Required For Compliance w/29 CFR 1910.120(q)
- Fire Department/Safety/SLS Teams Determine Facility Modifications & Procedures/Management/Training Required For Compliance w/29 CFR 1910.119



45th SPW Launch Site Fire Protection Requirements Analysis

ANALYSIS PROCESS (CONTINUED)

- Deficiencies & Requirements Are Documented IAW AFR 127-2 & AFR 127-12 Hazard Reporting/Abatement Processes (AF Forms 3 & 457). Fire Department Technical Assistance Will Be Available, If Required
- Each SLS Prepares/Submits/Follows Up Hazard Deficiency and Facility Modification Project/Other Documentation IAW Unit Commander/Supervisor Responsibilities Specified In AFR 127-Series Regulations
- Applicable Prime Contractors Develop/Implement/Train OSHA-Compliant Company Hypergol Release Incident Emergency Response Plans (29 CFR 1910.120 (q)), A Workplace Hazard Communication Program (29 CFR 1910.1200), Employee Emergency Action Plans & Alarms (29 CFR 1910.38(a)) & Facility Process Safety Management Program Plan (29 CFR 1910.119)

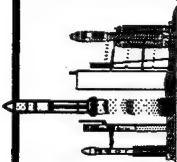


45th SPW Launch Site Fire Protection Requirements Analysis

OSHA 29 CFR 1910.119 Process Safety Management Of Highly Hazardous Chemicals

PURPOSE

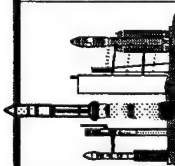
Prevent or minimize "the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals. These releases may result in toxic, fire or explosion hazards."



45th SPW Launch Site Fire Protection Requirements Analysis

OSHA 29 CFR 1910.119 Process Safety Management Of Highly Hazardous Chemicals

- Applies To CCAS Processes Involving 100 lbs or More of Hydrazine-Based Fuel And 250 lbs of Nitrogen Tetroxide. Other Chemicals TBD Pending Further Analysis
- Applies To All CCAS Facilities Where A Process Involving N_2H_4 & N_2O_4 Takes Place
- Applies To Owners Of Facilities Where A Highly Hazardous Chemical Process Takes Place
- Applies To Employers Of People Who Work In Facilities Where Highly Hazardous Chemical Processes Take Place



45th SPW Launch Site Fire Protection Requirements Analysis

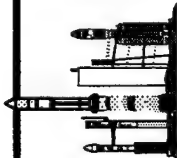
OSHA/AFOSH OCCUPATIONAL SAFETY & HEALTH STANDARDS Generalized USAF - Government Contractor Responsibilities For HAZMAT Emergency Response & Process Safety Management (PSM)

CCAS Facility & Process Owner (USAF Commanders & Supervisors)

- Provide A Workplace In Compliance w/OSHA, DOD & USAF Standards
- Provide Resources For Fully Compliant Procedures, Facilities & Installed Systems & For Correcting Deficiencies
- Operate & Maintain (Or Provide For O&M) Of Installed Systems Per Standards
- Maintain Compliant Workplace Safety Policy & Procedures, Enforcement & Training
- Establish Policy & Procedures To Ensure An OSHA-Compliant HAZMAT Emergency Response Capability Is Constituted & Trained By Employers of Emergency Response Participants
- Establish Policy & Procedures To Ensure An OSHA-Compliant PSM Programs Are Established And Maintained By Facility Users

Employers of Persons Conducting HAZOPS (Contractor Executives & Supervisors)

- Insure Fully-Compliant, Safe Workplaces
- Maintain Compliant Workplace Safety Policy & Procedures, Enforcement & Training
- Conduct Operations IAW OSHA/AFOSH Standards
- Comply W/The OSHA HAZMAT Emergency Response Standard, 29 CFR 1910.120 (q) (Only If Employees Are Emergency Responders)
- Comply W/The OSHA Process Safety Management Standard, 29 CFR 1910.119 (Only For Processes Defined As Involving Highly Hazardous Chemicals Per OSHA 29 CFR 1910.119)



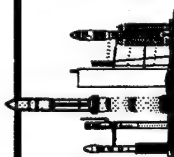
45th SPW Launch Site Fire Protection Requirements Analysis

OSHA 29 CFR 1910.119

Process Safety Management Of Highly Hazardous Chemicals

REQUIREMENTS

- Employee Participation in Development of All PSM Plans, Hazard Analyses & Other Elements Required By The Standard. Employee Access To All Information.
- Process Safety Information On Highly Hazardous Chemicals - Toxicity, Flammability, Permissible Exposure Limits, etc. Also Process Equipment Specifications, Designs, Materials, etc.
- Process Hazard Analysis (PHA) - Identify Evaluate & Control Process Hazards
50% Of PHAs Complete By May 26, 1995/100% By May 26, 1997
- Written Operating Procedures - Provide Clear Instructions For Safely Conducting Activities Involved In each Process Consistent W/Process Safety Info & Hazards
- Training - Initial, Refresher (3 Yrs) & Training Documentation
- Employer Flowdown of Hazard Data To Other Contractors - Facility/Equipment O&M/Repair Contractors. Contract Employer Responsibilities.
- Pre-Startup Safety Review - New or Significantly Modified Facilities/Equipment



45th SPW Launch Site Fire Protection Requirements Analysis

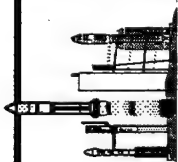
OSHA 29 CFR 1910.119

Process Safety Management Of Highly Hazardous Chemicals

REQUIREMENTS (Continued)

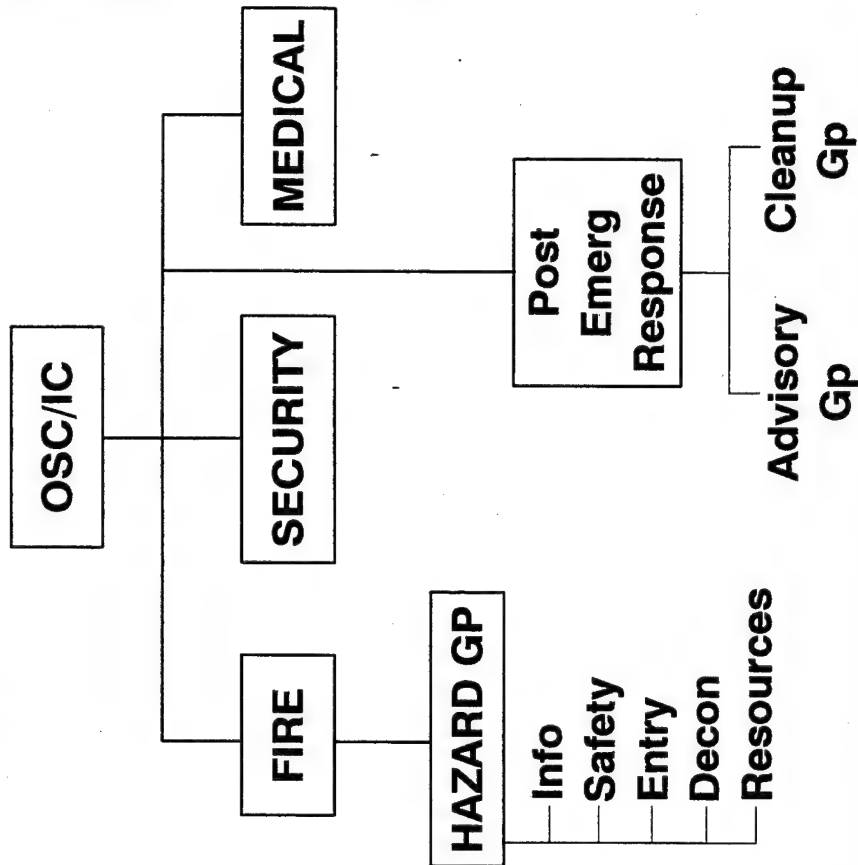
- Mechanical Integrity - Written Procedures, training For Process Maintenance, Inspection/Testing of Process Equipment, Deficiency Correction & QA
- Hot Work Permit - Authorizes Hot Work Near A Covered Process
- Management Of Change - Written Procedures To Manage Changes In Process Procedures, O&M, Equipment, Technologies Or Chemicals
- Incident Investigation - Applies To Incidents that Resulted In or Could Have Resulted In A Catastrophic release. Requires Prompt Action & Report By A Qualified Team.
- Emergency Planning & Response - Requires Emergency Action Plan IAW 29 CFR 1910.38 (a) & HAZMAT Emergency Response Program IAW 29 CFR 1910.120 (q) If Employees Direct/Participate In The Response
- Compliance Audits/Certifications - Every 3 Years
- Trade Secrets - Sufficient Data For Process Safety Must Be Made Available

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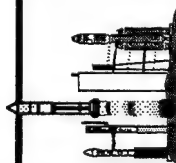


45th SPW Launch Site Fire Protection Requirements Analysis

AFI 32-4002 Hazardous Material Emergency Planning And Response Compliance



- HAZMAT Response Team
 - Evaluates Response Hazards & Risks
 - Fights Fires
 - Makes Rescues
 - Controls & Contains HAZMAT Releases
- Post-Emergency Response Team
 - Advisory Group Oversees Cleanup
 - Cleanup Group



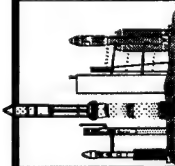
45th SPW Launch Site Fire Protection Requirements Analysis

AFI 32-4002

Hazardous Material Emergency Planning And Response Compliance

- Prevention, Planning, Training, Notification & Reporting IAW
OSHA, EPA & DOT Federal Standards
- Training Standard = NFPA 471, Professional Competence of Responders
To Hazardous Materials Incidents
- Incident Commander Training Requirements

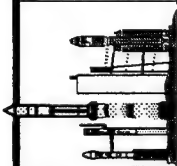
	Senior Fire Officer	Base Commander
OSHA/NFPA On-Scene Commander	●	●
OSHA Emergency Action Plans	●	●
Process Safety Management	●	●
Confined Space Rescue	●	
OSHA HAZCOM & Lab Safety	●	●
EPA Oil Pollution Response	●	●
EPA HAZ Waste	●	●
EPA National Contingency Plan (Oil & HAZMAT)	●	●
PCB Spill Response	●	●



45th SPW Launch Site Fire Protection Requirements Analysis

ANALYSIS TEAM APPROACH

- Review Relevant Fire Protection, Life Safety & HAZMAT Release Incident Response Standards (USAF, OSHA & NFPA Cites Provided Separately)
- Determine Which Standards Apply For Minimum Compliance
- Document Launch Site & Support/Processing Facility Baselines
 - Facility Configurations/Installed Systems/Portable Systems
 - USAF & Contractor Written Plans, Policies & Procedures That Comply w/ OSHA HAZCOM/HAZMAT Emergency Response Statutory Requirements
- ID & Document Launch Site Hazards/Threats
 - Electrical Fire Locations & Conditions
 - Propellant Release Mechanisms & Quantities
 - Fire/Release Incident Occurrence Frequencies
 - Mitigating Systems, Procedures, Equipment & Conditions
 - On-Board Payload Threats (Batteries/Fuels/Electrical Systems/Motors)
 - Probable Outcomes (Fire/Explosion/Vapor Plume)



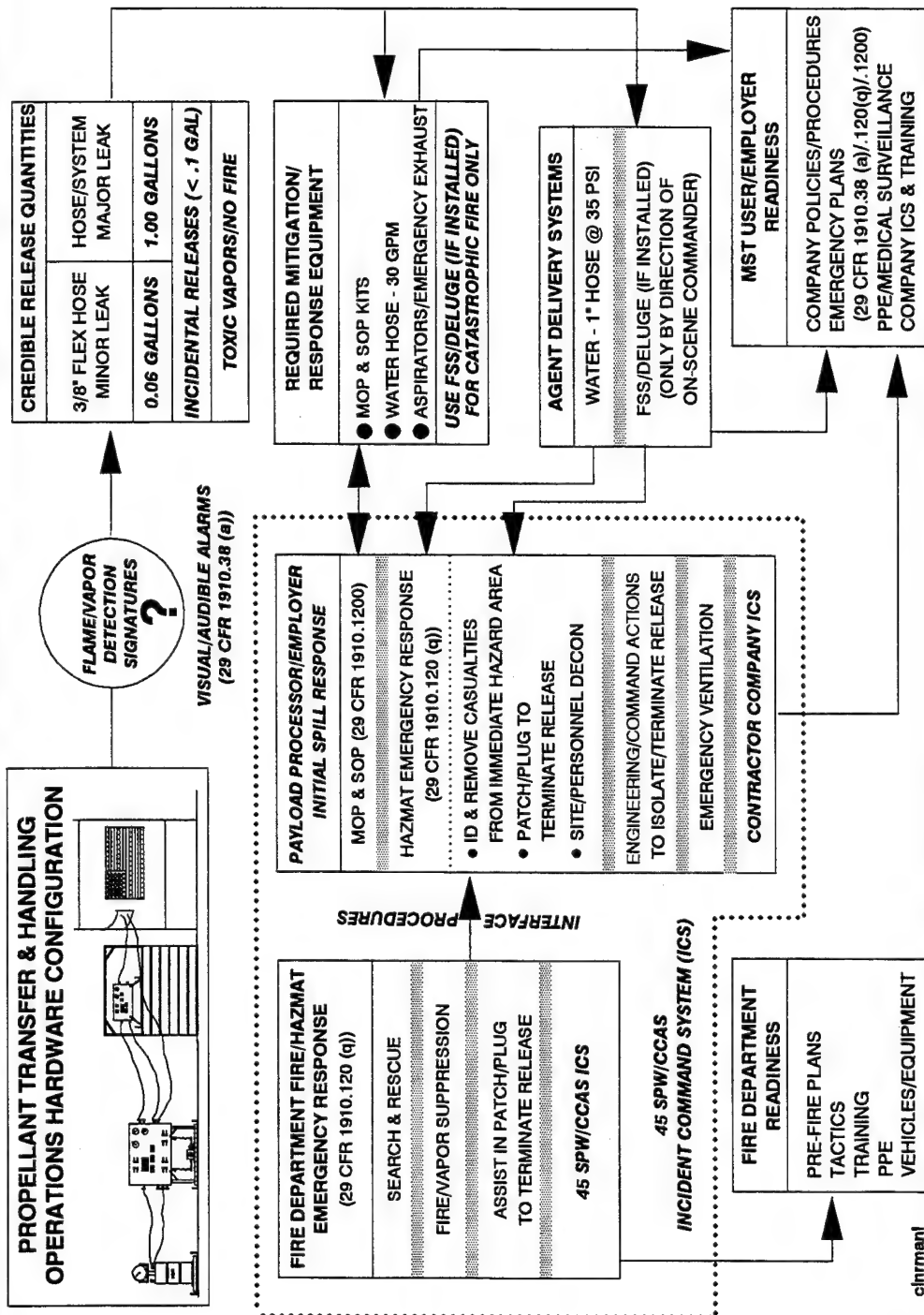
45th SPW Launch Site Fire Protection Requirements Analysis

ANALYSIS TEAM APPROACH (Continued)

- Conduct Fire Protection Engineering & Trade-Off Analyses To Identify The Minimum Required Hardware & Procedures Required To The Meet Mandatory Fire Protection, Life Safety & HAZMAT Incident Response Requirements Identified By The Team
- Use Hazard & Engineering Analysis Results To Document/Program Hazard Abatement Projects and To Contractually-Mandate SLS User Compliance With OSHA HAZCOM & HAZMAT Emergency Response Requirements

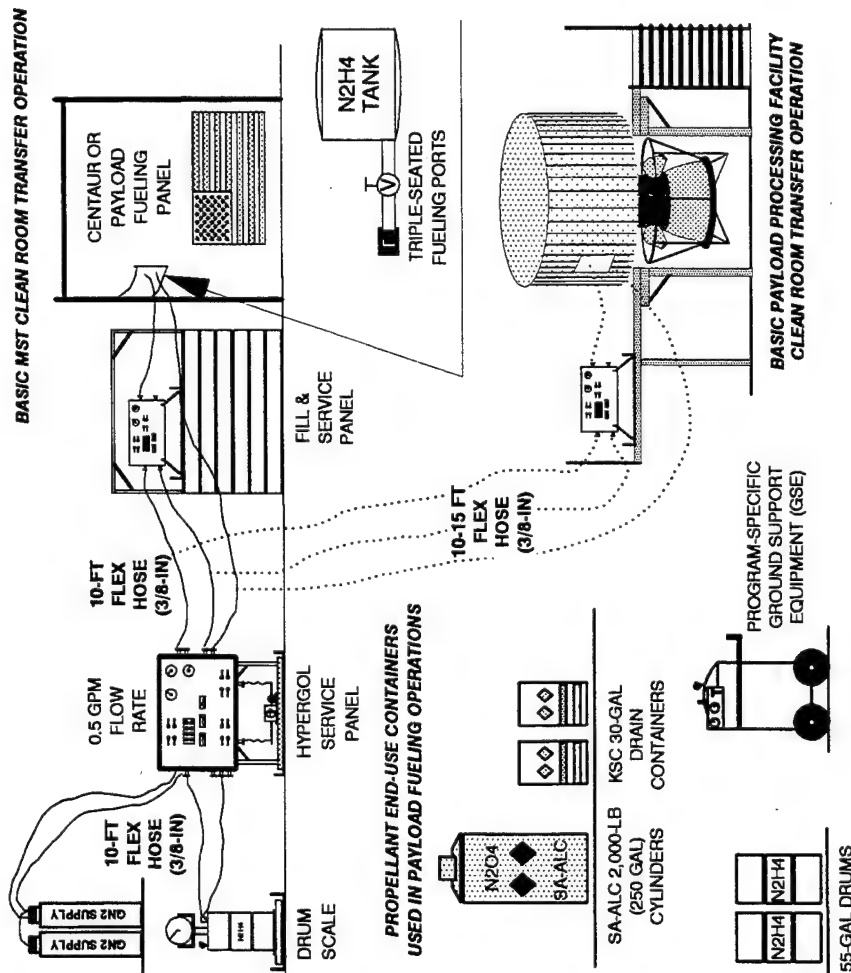
45th SPW Launch Site Fire Protection Requirements Analysis

FIRE DEPT & USER REQUIREMENTS IDENTIFICATION - MST CLEAN ROOM HYPERGOL RELEASE



45th SPW Launch Site Fire Protection Requirements Analysis

HAZARD ANALYSIS EXAMPLE - CLEAN ROOM PAYLOAD FUELING OPERATION



Credible Release Mechanism/Release Quantity

- Improper Seating or Failure of Connection Hardware or Stainless Steel Flexible Transfer Hose Section
- Immediate Identification of Leak:
- Delayed Identification of Leak:

Release Quantity = Transfer Hose Volume

Release Quantity = Transfer Rate X 2 min

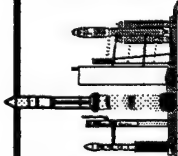
Hazard Summary

PAYLOAD HYPERGOLIC FUEL & OXIDIZER TANK CAPACITY (GALLONS)			HYPERGOL FUELING SYSTEM TRANSFER PARAMETERS				
N2H4	MMH	N2O4	X-FER HOSE DIA. (IN.)	X-FER HOSE LENGTH (FT.)	X-FER HOSE VOLUME (GAL.)	X-FER RATE (GPM)	MAX CRED REL * (GAL.)
30-250+	55-250+	250 +	0.375	10	0.06	0.5	1.0

* - MAX CREDIBLE RELEASE = RATE x 2 MIN

Probable Consequences

Toxic Vapor Threat - No Fire



45th SPW Launch Site Fire Protection Requirements Analysis

Objective Guidance: NFPA 101, Life Safety Code

- **Chapter 2, Fundamental Requirements**

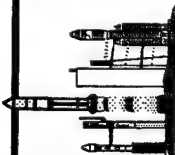
Section 2-1 - "Every building or structure, new or old, designed for human occupancy shall be provided with means of egress and other safeguards sufficient to permit the prompt escape of occupants or shall furnish other means to provide a reasonable degree of safety for occupants."

- **Chapter 4, Hazard Of Contents**

Section 4-2.1.2 - "Hazard of contents shall be determined by the authority having jurisdiction on the basis of the character of the contents and the processes or operations conducted in the building or structure. other means to provide a reasonable degree of safety for occupants."

- **Chapter 30, Special Structures & High Rise Buildings, Commentary on Section 30-3.2, Protection From Hazards**

"The provisions of Section 30-3.2 require careful analysis by Code users to ensure that fire protection required for life safety is provided. The key element of the requirement is that the fire protection be adequate to safeguard occupants during the time required to reach exits. Fire protection systems that may be needed for property protection or to control fire losses in a process or occupancy will, in many cases, be excessive for the life safety of the occupants, and are beyond the scope of this code."

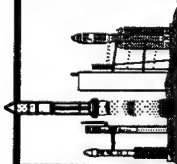


45th SPW Launch Site Fire Protection Requirements Analysis

Mandatory Life Safety Requirements (HQ AFSP/CE/SE Ltr, 12 May 94)

NFPA 101, Section 5-11, Special Provisions For Occupancies With High Hazard Contents

- 5-11.1: -----"exits of such types and numbers shall be provided and arranged to permit all occupants to escape from the building or structure or from the the hazardous area thereof to the outside or to a place of safety with a travel distance of not more than 75 ft, measured as specified in 5-6.2."
- 5-11.3: "At least two means of egress shall be provided from each building or hazardous area thereof."
- 5-11.4: "Means of egress shall be arranged so that there are no dead ends in corridors."

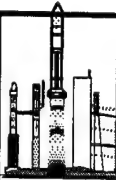


45th SPW Launch Site Fire Protection Requirements Analysis

WHAT IS AN EMERGENCY?

(IAW OSHA 29 CFR 1910.120(q), Emergency Response To Hazardous Substances Releases)

- OSHA: A Response Effort By Employees From Outside The Immediate Release Area Or By other Designated Responders (i.e. --- Fire Departments, etc.)
- NASA KSC:
- ● "INCIDENTAL SPILL": Handled Internally By The Organization/Contractor Conducting The HAZOP. Safety/Environmental Spill Reporting Required. Includes Plug, Mop, Sop & Decon By Company Employees In Proper PPE.
- ● "EMERGENCY SPILL RESPONSE": Fire Department/911 Called
 - User Org/Company Must Assist Fire Dept In Leak ID & Termination (i.e. Participate In The Emergency Response)
 - User Org/Company Must Cleanup & Decon Spill Area & Their Personnel
- ● Company Employees Who Participate In The Emergency Response Must Be Trained, Equiped & Led IAW 29 CFR 1910.120(q) Under Company Emergency Response Plans & A Medical Surveillance Program



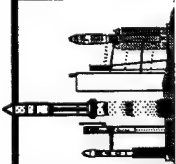
45th SPW Launch Site Fire Protection Requirements Analysis

HYPERGOLIC PROPELLANT HAZARD ANALYSIS SUMMARY

RELEASE SITUATION	RELEASE MECHANISM	MATERIAL RELEASED	CREDIBLE RELEASE (GAL)		FIRE DEPARTMENT CONSEQUENCES
			MINOR	MAJOR	
PROPELLANT SAMPLING ACCIDENT	OVERFILLED/DROPPED SAMPLE FLASK HOSE/CONNECTION LEAK	N2O4 N2H4 A-50 MMH	0.03	0.25	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
PROPELLANT CONTAINER/ TANKER MAINTENANCE ACCIDENT	UNDETECTED RESIDUAL RELEASED DURING TEAR-DOWN	N2O4 N2H4 A-50 MMH	0.25	0.25	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
ROADWAY TRANSPORTATION VEHICLE ACCIDENT W/ CONTAINERS OR TRAILERS	WELD BREAK WALL PENETRATION LEAKING CONNECTION STEM	N2O4 N2H4 A-50 MMH	7.5 - 12.0	55 - 120	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
DROPPED CONTAINER - LOADING/UNLOADING ACCIDENT	WELD BREAK WALL PENETRATION LEAKING CONNECTION STEM	N2O4 N2H4 MMH	7.5	12.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
ROADWAY VEHICLE ACCIDENT W/GLASS & HOKE BOTTLE SAMPLES	BROKEN GLASS BOTTLE LEAKING HOKE BOTTLE	N2O4 N2H4 A-50 MMH	0.25	1.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
TRANSPORTATION OR PAY- LOAD MATING ACCIDENT W/ FUELED SATELLITE	SHOCK-INDUCED LEAK FUEL TANK PENETRATION	N2O4 N2H4 MMH	7.5	12.0	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
BULK HYPERGOL STORAGE TANK LOAD OR OFFLOAD ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.27	CCAS 200	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			7.34	VAFB 300	
LAUNCH VEHICLE FHA/OHA/UT FUEL/DEFUEL ACCIDENT/INCIDENT	CONNECTION LEAK MINOR HOSE FAILURE MAJOR MATERIAL FAILURE	N2O4 A-50	1.84	DELTA 40	PROBABLE FUEL FIRE OXIDIZER SPILL RESPONSE
			23.13	TITAN 400	
PAYLOAD PROCESSING FACILITY INCIDENT DURING SATELLITE FUELING/TESTING	CONNECTION LEAK MINOR HOSE FAILURE	N2O4 N2H4 MMH	0.06	1.0	FUEL SPILL RESPONSE OXIDIZER SPILL RESPONSE

PORTABLE PROPELLANT CONTAINER SUMMARY

- 55 GAL DRUMS (LEAST SAFE)
- KSC 5/30 GAL DOT/ASME DRAIN CONTAINERS
- SA-ALC 2,000 LB CYLINDERS
- PROGRAM-SPECIFIC GSE CARTS
- VAFB/VENDOR 5,000 GAL TANKERS
- KSC 500 GAL GPTU
- KSC/VENDOR 2,500 GAL TANKERS
- 10,000 GAL RAIL CARS (MOST SAFE)

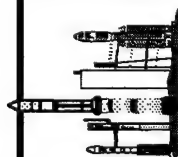


45th SPW Launch Site Fire Protection Requirements Analysis

MST Clean Room Fire Protection, Life Safety & HAZMAT Emergency Response Hazard Analysis Baseline

Strawman Example

- Threat Data
- Probable Propellant Hazard Scenario & Consequences
- Probable Facility Electrical System Hazard Scenario & Consequences
- Probable Payload Electrical System Hazard Scenario & Consequences
- Threat Mitigating Systems/Procedures
- Facility Life Safety Configuration
- Spill/Release Response Factors
- "Day-To-Day"/Routine Operations/Other Considerations

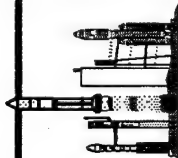


45th SPW Launch Site Fire Protection Requirements Analysis

MST Clean Room Fire Protection, Life Safety & HAZMAT Emergency Response Hazard Analysis Baseline (Continued)

Threat Data

- N2H4 - 30 Gal Drain Containers, 55 Gal Drums, GSE Cart (30 - 250 Gal)
- N2O4 - 250 Gal Cylinders (250+ Gal)
- Propellant Transfer @ 0.5 GPM Thru 3/8" SS Flex Hose
- Fixed Electrical & Mechanical Systems - TBD
- Portable Electrically Powered/Electronic Test Equipment - TBD
- On-Board Propellant Storage Tanks (20 - 250+ Gal)
- On-Board Electrical/Electronic Systems/Batteries - TBD
- Unattended Charged On-Board Propellant Tanks & Prepositioned Supply Containers - TBD



45th SPW Launch Site Fire Protection Requirements Analysis

MST Clean Room Fire Protection, Life Safety & HAZMAT Emergency Response Hazard Analysis Baseline (Continued)

Probable Propellant Hazard Scenario & Consequences

- Likely Occurance: Pressurized Transfer Hose or PTU Component Failure
- Frequency Of Occurance: TBD (Expected to Be Low - Highly Structured Procedures)
- Probable Release Quantity: 0.5 GPM X 2 Min = 1 Gallon
- Probable Release Consequences: Toxic Vapors/No Fire
- Employee Risk: Minimal: Personnel In SCAPE
- Facility Risk: None
- Payload Risk: Minimal - Vapor Contact & Material Incompatability
Depends on Location Of Release & Concentration

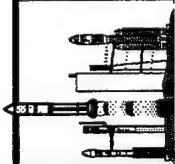


45th SPW Launch Site Fire Protection Requirements Analysis

MST Clean Room Fire Protection, Life Safety & HAZMAT Emergency Response Hazard Analysis Baseline (Continued)

Probable Facility Electrical System Hazard Scenario & Consequences

- Likely Occurrences: (1) HVAC Fires, (2) Electrical Circuit Overload/Fire
- Frequency Of Occurance: (1) TBD, (2) TBD
- Probable Consequences: Toxic Smoke, Particulate Contamination, Fire Spread To Adjacent Combustibles (Wiring/Plastics)
- Employee Risk: Low - Smoke Inhalation. Fire Impingement On Propellant Tanks Unlikely
- Facility Risk: Moderate - Localized System Replacement
- Payload Risk: High - Smoke/Soot Products of Combustion

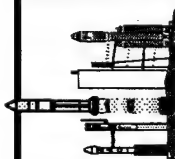


45th SPW Launch Site Fire Protection Requirements Analysis

MST Clean Room Fire Protection, Life Safety & HAZMAT Emergency Response Hazard Analysis Baseline (Continued)

Probable Payload Electrical System Hazard Scenario & Consequences

- Likely Occurrences: (1) Electrical Circuit Overload/Fire, (2) Battery Fire
- Frequency Of Occurance: (1) TBD, (2) TBD
- Probable Consequences: Toxic Smoke, Particulate Contamination, Fire Spread To Adjacent Combustibles (Wiring/Plastics)
- Employee Risk: Moderate - Smoke Inhalation. Fire Impingement On Propellant Tanks Possible. Employees Not In SCAPE
- Facility Risk: Low - If Contained In Payload
- Payload Risk: Very High - Smoke/Soot Products of Combustion, Fire/Heat Spread To Adjacent Components

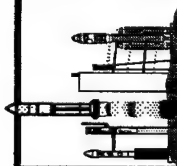


45th SPW Launch Site Fire Protection Requirements Analysis

**MST Clean Room Fire Protection, Life Safety
& HAZMAT Emergency Response Hazard Analysis Baseline (Continued)**

Threat Mitigating Systems/Procedures

- Scuppers/Drip Pans To Contain Liquid & Vapor Releases - Max Quantity TBD
- Installed Emergency Ventilation To Remove/Collect Released Vapors
 - TBD CFM During Propellant Transfer
 - TBD CFM During Release Emergency
- Point Leak Aspirators - Number & CFM TBD
- Hypergolic Vapor Detectors
 - Fixed System - TBD PPM Threshold
 - Portable System - TBD PPM Threshold
- SS Construction, Limited/No Class A Combustibles
- Fire Protection
 - Fixed System Detection - TBD
 - Fixed System Suppression - TBD
 - Portable Extinguishers - TBD
 - Water Hose (s)/Water Source - TBD
- Process Procedures & Employee Training - TBD
- Emergency Action Procedures & Employee Training - TBD

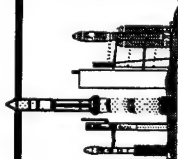


45th SPW Launch Site Fire Protection Requirements Analysis

MST Clean Room Fire Protection, Life Safety & HAZMAT Emergency Response Hazard Analysis Baseline (Continued)

Facility Life Safety Configuration

- Clean Room Location: Elevated - TBD Ft Above Surface/TBD Stories
- Dimensions/Plan View - TBD (Room w/in a Room? - TBD)
- Adjacent Rooms/Levels (Above/Below/Same Level) - TBD
- Clean Room Exits: Size, Location & Swing - TBD
- Exit Corridors: Air Locks/Equipment Rooms/Etc. - TBD
- Corridor Exits: Size Location & Swing - TBD
- Escape Stairwells - TBD
- Escape Chutes/Devices - TBD
- Personnel Loadings On All Levels During Threat Process Ops - TBD
- Emergency Lighting - TBD
- Escape Route Signage & Illumination - TBD
- Audible/Visible Alarms - TBD



45th SPW Launch Site Fire Protection Requirements Analysis

MST Clean Room Fire Protection, Life Safety & HAZMAT Emergency Response Hazard Analysis Baseline (Continued)

Spill/Release Response Factors

- Contractor Company Plans, Policies, Procedures & Training - TBD

Incidental Propellant Releases

Emergencies

Fires

Propellant Releases

- Counterpart SLS Plans, Policies, Procedures & Training - TBD
- CCAS Fire Dept Plans, Policies, Procedures & Training - TBD
- Total CCAS Integrated/Deconflicted Plans, Policies, Procedures & Training - TBD
- Contractor & Fire Dept Spill/Release Response Equipment - TBD

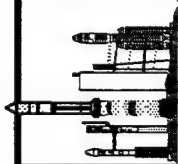
Mop & Sop Kits

Fire Extinguishing Agents

Response PPE

Evacuation PPE - Emergency Air Packs/Masks

Site Decon Equipment

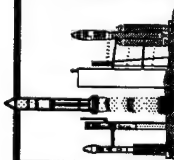


45th SPW Launch Site Fire Protection Requirements Analysis

MST Clean Room Fire Protection, Life Safety & HAZMAT Emergency Response Hazard Analysis Baseline (Continued)

"Day-To-Day"/Routine Operations/Other Considerations

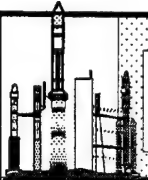
- Launch Vehicle/Payload Present
- Launch Vehicle/Payload Not Present
- Facility O&M Tools, Equipment, Solvents, Paints, Etc.
- Missile/Payload Support Equipment Calibration/O&M - Fixed/Portable
- Facility O&M - Electrical, HVAC, Structural/Welding
- Elevator & Crane Ops/O&M
- Other Combustible Loadings



45th SPW Launch Site Fire Protection Requirements Analysis

WHICH STANDARDS APPLY?

- OSHA, AFOSH, DOD & USAF Standards Require Fire Protection Systems, Safe Means of Emergency Egress & Emergency Procedures For Facilities Involving Hazardous Operations, that Contain Ultra High Value/Mission-Essential Electronics Equipment, that Store/Contain Flammable or Hazardous Chemicals And Hazardous Processes/Operations, And That Are High-Rise, "Special" and/or Industrial Facilities.
- *(Existing CCAS Launch Site Facilities, MST Clean Rooms & Ground-Level Clean Rooms With Payloads Are Similar To One or More Of The Above Facility Categories).*
- *A Compendium Of Standards With Potential or Mandatory Applicability To SLS Facilities/Contractors Is Provided By Separate Cover. Pls review & Add Additional Cites Per Your Experience/Knowledge.*
- The Draft ERR 127-1, Range Safety Standards, Requires Installed Optical Fire Detection, Water Spray Fire Suppression and Hypergolic Vapor Detection Systems in New Construction of "Enclosed Hypergolic Propellant Processing Facilities." (I.E. MST & Ground-Level Clean Rooms). ERR 127-1 Is Based On TBD OSHA, DOD & USAF Facility Standards
- 45 SPW Must Deconflict Standards Between New & Existing Facilities.



45th SPW Launch Site Fire Protection Requirements Analysis

Clean Room Life Safety & Fire Protection Requirements Cross-Reference

Definition - High Hazard Contents

OSHA 1910.35

Fire Detection

Draft ERR 127-1

MIL-HDBK-1008B, Ordnance Facility & Flammable/Hazardous Storage

ETL 93-5, Electronic Equipment Installations

Slide Escapes

NFPA 101, Para 28-2.2.11

AFR 127-100, Para 8-19, Safety Chutes

Portable Fire Extinguishers

OSHA 1910.157(c) - Extinguisher General Requirements

OSHA 1910.106(e)(5) - Flammable & Combustible Liquids

AFR 127-100, Para 3-7a, Fire Extinguishers

Fixed Fire Suppression

Draft ERR 127-1

OSHA 1910.106(e)(5) - Flammable & Combustible Liquids

NFPA 101, Para 28-3.2 & 30-3.2, Protection From Hazards

AFR 127-100, Para 8-42, Deluge Systems

MIL-HDBK-1008B, Ordnance Facility & Flammable/Hazardous Storage

ETL 93-5, Electronic equipment Installations

Vapor Detection

Draft ERR 127-1

Fire Wall Enclosed Processing Area

NFPA 101, Para 30-3.2, Protection From Hazards

AFR 127-100, Para 8-15a, Fire walls

Protected Egress

HQ AFSPC/SE/CE Interim Policy Ltr, 12 May 94

OSHA 1910.36/.37 - Means of Egress

NFPA 101, Para 28-2.1.4 & Sect 5-11 - Means of Egress/Special Hazard Provisions

AFOOSH 127-56 - Compliance w/NFPA 101

HQ AFSPC/SE/CE Interim Policy Ltr, 12 May 94

AFR 127-100, Para 8-19, Building Exits

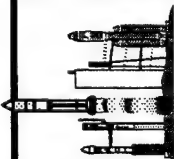
Spill/Release Emergency Plans & Training

OSHA 1910.38(a) - Emergency Action Plan

OSHA 1910.120(q) - Emergency Response From Outside Area

OSHA 1910.1200 - Incidental Spill Cleanup Per MSDSs

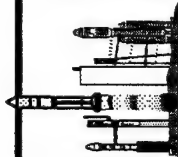
HQ AFSPC/SE/CE Interim Policy Ltr, 12 May 94



45th SPW Launch Site Fire Protection Requirements Analysis

RECAP

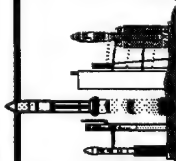
- OSHA/AFOSH-Compliant Policy On Launch Tower/Site Fire Protection, Life Safety & HAZMAT Emergency Response Required by OSHA/USAF/HQ AFSPC
- Proposed Joint Fire Department - SLS Team Approach To Conduct & Identify Fire Protection & Life Safety Upgrade Requirements
- Upgrade/Modification Requirements Based On "Best Fit" of OSHA/AFOSH/NFPA/DOD/USAF Standards To Provide Worker Safety
- Develop USAF-Contractor Plans & Procedures For Integrated SLS Launch Facility Incidental Spill Response & Spill/Fire Emergency Response
- Suggestion: Retain Registered Professional FPE To Review All Req'd Standards
- Prepare 45 SPW Policy Ltr Based On Analyses Results



45th SPW Launch Site Fire Protection Requirements Analysis

SLS/CEF ACTION ITEMS

- Select Analysis Team
- Schedule Baseline Data Collection
- Define Required Standards
- Conduct Hazard Analysis
- Determine & Document Required Facility/Equipment/Procedural Improvements
- ID & Retain Registered FPE (Prime Contractor)
- ECD - NLT 15 Jan 95
- 45 SPW/CC Policy Ltr Coordinated & Signed - 1 Feb 95

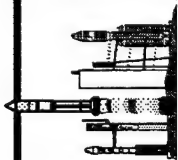


45th SPW Launch Site Fire Protection Requirements Analysis

REQUIRED STANDARDS STRAWMAN

Rules Of Engagement

- **Mandatory:** USAF/OSHA/NFPA 101 Standards On Employee Life Safety & Employee Response To HAZMAT/Hypergol Release Incidents & Fires
- **Discretionary:** Application of NFPA & USAF Fire Detection & Suppression System Standards To Protect Facilities And/Or Special Structures Housing Propellants & Transfer Operations And/Or Ultra-High Value Contents



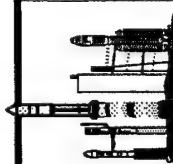
45th SPW Launch Site Fire Protection Requirements Analysis

REQUIRED STANDARDS STRAWMAN

Rules Of Engagement (Continued)

MINIMUM THREAT

- Clean Rooms: 1-Gallon N₂H₄ or N₂O₄ Release
Toxic Vapors
No Fire
- All Other Facilities:
Maximum Major N₂H₄ or N₂O₄ Release < 400-Gallons
Toxic Vapors/Plume
N₂H₄ Fire
Possible N₂O₄-Enriched Fire



45th SPW Launch Site Fire Protection Requirements Analysis

REQUIRED STANDARDS STRAWMAN (Continued)

Required Standards For CCAS Facilities Involving Hypergolic Chemical Dynamic Transfer Operations

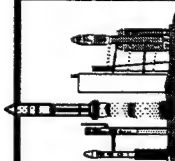
Requirement Description	Reference
<ul style="list-style-type: none"> ● USAF & CCAS Contractor Compliance With OSHA Standards For Emergency Response To Hazardous Substances Releases 	OSHA 1910.120(q)
<ul style="list-style-type: none"> ● USAF & CCAS Contractor Compliance With The OSHA Hazard Communication Standard 	OSHA 1910.1200
<ul style="list-style-type: none"> ● Integrated/Deconflicted CCAS ICS And Hypergol Incident Response Procedures And Training For All USAF & Contractor Responders 	OSHA 1910.120(q) & HQ AFSPC Policy Ltr
<ul style="list-style-type: none"> ● Publication & Training Of USAF & CCAS Contractor Emergency Action Plans For Employees Not Involved In Hypergol emergency Response 	OSHA 1910.38(a) Employee Emergency Plans
<ul style="list-style-type: none"> ● Audible & Visible Alarms IAW OSHA 1910.165 	OSHA 1910.38(a) Employee Emergency Plans
<ul style="list-style-type: none"> ● TBD Slide Escapes From Launch Tower Elevations Where Manned, Dynamic Propellant Transfer Operations Take Place. These May Be Wire-Basket Slides As On LC 39A/B Or Approved Commercial Emergency High Rise Chutes 	NFPA 101, Section 28-2.2.11 AFR 127-100, Para 8-19
Clean Room Emergency Egress <ul style="list-style-type: none"> ● A Minimum Of Two Egress Routes From Clean Rooms To Adjacent Areas That Are Emergency Exits Or Lead To An Access Route To An Emergency Exit 	OSHA 1910.36 Means Of Egress General Requirements

45th SPW Launch Site Fire Protection Requirements Analysis

REQUIRED STANDARDS STRAWMAN (Continued)

Required Standards For CCAS Facilities Involving Hypergolic Chemical Dynamic Transfer Operations

Requirement Description	Reference
Clean Room Emergency Egress (Continued)	
● Clean Room Exit Access Arranged To Prevent Emergency Travel Toward The High Hazard Location	OSHA 1910.37 Means Of Egress
● At Least 1 MST Launch Tower Clean Room Exit To An Exterior Direct Balcony To An Exterior Stairwell And/Or Emergency Escape Slide Device/Chute	AFR 127-100, Para 8-19
● A Second MST Launch Tower Clean Room Exit And Subsequent Escape Pathway That Leads To A Second Breakout Exit With Immediate Access To An Exterior Balcony Or Stairwell To An Emergency Escape Slide Device/Chute	NFPA 101, Chapter 5 Means Of Egress
Clean Room Fire Suppression Equipment	
● TBD Fire Extinguishers Inside Each Clean Room	OSHA 1910.106(e)(5) Flammable & Combustible Liquids - Fire Control
● TBD Fire Extinguishers Inside Each MST Enclosed Room Or Area Containing NFPA Class A, B or C Flammable Hazards	
● At Least One Water Hose (1-in Diameter/35 PSI) & Adjustable Nozzle In Sufficient Length To Reach All Potential Hypergol Spill/Fire Areas	AFR 127-100, Paras 3-7a, 3-8 & 3-9
● Clean Room Water Supply At Specified Volume & Pressure	

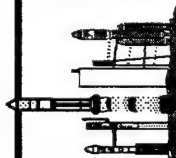


45th SPW Launch Site Fire Protection Requirements Analysis

REQUIRED STANDARDS STRAWMAN (Continued)

Required Standards For CCAS Facilities Involving Hypergolic Chemical Dynamic Transfer Operations

Requirement Description	Reference
Clean Room Detection & Vapor Threat Mitigation Systems	
<ul style="list-style-type: none"> ● HAZOPS HVAC - TBD Air Exchanges/Hr ● Emergency Release Ventilation - N2H4 Concentration < 0.20 LEL (1-Gallon) ● TBD Portable Vapor Aspirators At Each Transfer Connection Point ● Vapor Detection <ul style="list-style-type: none"> - Fixed N2H4 & N2O4 (If Applicable) Detectors - Alarm Threshold = TBD PPM - Portable N2H4 & N2O4 (If Applicable) Detectors - Alarm Threshold = TBD PPM ● TBD Explosion Venting ● TBD N2H4 Flame Detectors ● All Detection Systems Integrated Into Local & Area Alarm Systems W/Status Monitor(s) In Appropriate Command/Control Center(s) 	<p>NFPA 101, Section 30-3.2 Protection From Hazards</p> <p>NFPA 101, Section 28-3.2 Protection</p>

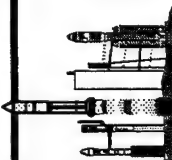


45th SPW Launch Site Fire Protection Requirements Analysis

REQUIRED STANDARDS STRAWMAN (Continued)

Required Standards For CCAS Facilities Involving Hypergolic Chemical Dynamic Transfer Operations

Requirement Description	Reference
<i>Hypergol Storage & Bulk Transfer Facilities</i>	
● MIL-STD 882 Hazard Analysis For Critical Facilities	
● System Analysis & Design Based On Hazard Analysis Results	
● NFPA 15 1/2-Second Response Time Water Spray Deluge Over Processing/Transfer/Storage Areas	NFPA 30, Para 5-6.1.3
● False-Alarm Immune Optical Flame Detectors	
● Manual Emergency Power Cutoff (EPC) System - TBD	
● All Alarms Report To CCAS Fire Dept & 1 Other 24-hr Control Ops Center	



45th SPW Launch Site Fire Protection Requirements Analysis

REQUIRED STANDARDS STRAWMAN (Continued)

Required Standards For CCAS Facilities Involving Hypergolic Chemical Dynamic Transfer Operations

Requirement Description	Reference
<i>ERR 127-1 Standards For New "Enclosed" Hypergol Transfer/Processing Facilities</i>	
● MIL-STD 882 Hazard Analysis For Critical Facilities	ERR 127-1, Chapter 5, Paras 5.4 - 5.6 NFPA 30, Para 5-6.1.3
● System Analysis & Design Based On Hazard Analysis Results	
● NFPA 15 1/2-Second Response Time Water Spray Deluge Over Processing/Transfer/Storage Areas	
● False-Alarm Immune Optical Flame Detectors	
● Hypergol Vapor Detectors In Enclosed Processing Facilities	
● Manual Emergency Power Cutoff (EPC) System In Enclosed Processing Areas	
● Emergency Monitor & Control Panels In Enclosed Processing Areas	
● All Alarms Report To CCAS Fire Dept & 1 Other 24-hr Control Ops Center	

**Note: 45 SPW Needs To Consider Deconflicting Draft ERR 127-1
Criteria For New Facilities With The Proposed Launch Facility
Existing Launch Facility Upgrade Standards Strawman**

APPENDIX K

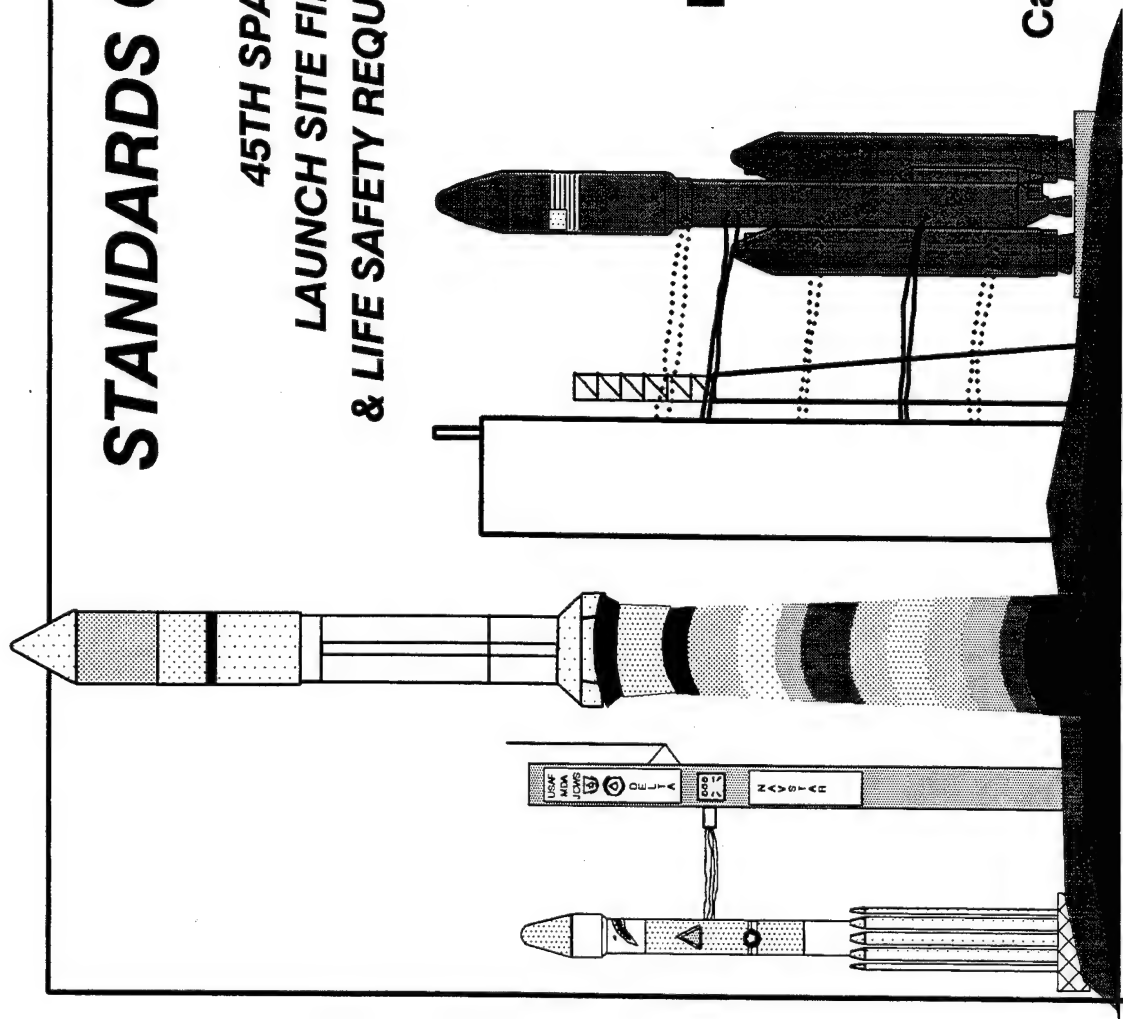
**BRIEFING PACKAGE: STANDARDS COMPENDIUM, 45TH SPACE WING
LAUNCH SITE FIRE PROTECTION & LIFE SAFETY REQUIREMENTS
ANALYSIS**

STANDARDS COMPENDIUM

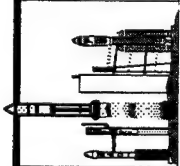
45TH SPACE WING
LAUNCH SITE FIRE PROTECTION
& LIFE SAFETY REQUIREMENTS ANALYSIS

45 CES/CEF
Fire Protection Office

Cape Canaveral Air Station, FL



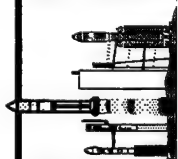
45THRT55



45th SPW Launch Site Fire Protection Requirements Analysis

29 CFR 1910, Occupational Safety & Health Standards

- 1910.157(c) - Portable Fire Extinguishers: General Requirements
 - (1) "The employer shall provide portable fire extinguishers and shall mount, locate and identify them so that they are readily accessible to employees without subjecting the employees to possible injury."
- 1910.106(e)(5) - Flammable & Combustible Liquids: Fire Control
 - (i) Portable and Special Equipment. "Portable fire extinguishment and control equipment shall be provided in such quantities and types as are needed for the special hazards of operation and storage."
 - (ii) Water Supply. Water shall be available in volume and at adequate pressure to supply water hose streams, foam-producing equipment, automatic sprinklers, or water spray systems, as the need is indicated by the special hazards of operation, dispensing and storage."
 - (iii) Special Extinguishers. "Special extinguishing equipment, such as that utilizing foam, inert gas, or dry chemical shall be provided as the need is indicated by the special hazards of operation, dispensing and storage."



45th SPW Launch Site Fire Protection Requirements Analysis

29 CFR 1910, Occupational Safety & Health Standards (Continued)

Subpart E - Means of Egress

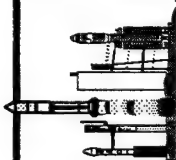
● 1910.35 Definitions

(e) High-hazard contents. "...those which are liable to burn with extreme rapidity or from which poisonous fumes or explosions are to be feared in the event of a fire."

● 1910.36 - General Requirements

(b)(8) Fundamental Requirement. "Every building or structure, section or area thereof of such size, occupancy and arrangement that the reasonable safety of numbers of occupants may be endangered by the blocking of any single means of egress due to fire or smoke, shall have at least two means of egress remote from each other, so arranged as to minimize the any possibility that both may be blocked by any one fire or other emergency conditions."

(d)(2) Maintenance. Every automatic sprinkler system, fire detection and alarm system, exit lighting, fire door and other item of equipment, where provided, be continuously in proper operating order."



45th SPW Launch Site Fire Protection Requirements Analysis

29 CFR 1910, Occupational Safety & Health Standards (Continued) Subpart E - Means of Egress (Continued)

● 1910.37 - Means of Egress, General

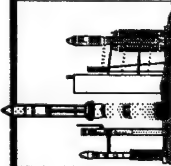
(b) Protective Enclosure of Exits. "When an exit is protected by separation from other parts of the building, the separating construction shall meet the following requirements."

(1) "The separation shall have at least a 1-hr fire resistance rating when the exit connects three stories or less."

(2) "The separation shall have at least a 2-hr fire resistance rating when the exit connects four or more stories, whether above or below the floor of discharge."

(f) Access to Exits.

(5) "Exit access shall be so arranged that it will not be necessary to travel toward any area of high hazard occupancy, in order to reach the nearest exit, unless the path of travel is effectively shielded from the high hazard location by suitable partitions or other physical barriers."



45th SPW Launch Site Fire Protection Requirements Analysis

29 CFR 1910, Occupational Safety & Health Standards (Continued) **Subpart E - Means of Egress (Continued)**

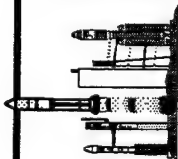
● 1910.37 - Means of Egress, General

(b) Protective Enclosure of Exits. "When an exit is protected by separation from other parts of the building, the separating construction shall meet the following requirements."

(2) "The separation shall have at least a 2-hr fire resistance rating when the exit connects four or more stories, whether above or below the floor of discharge."

(f) Access to Exits.

(5) "Exit access shall be so arranged that it will not be necessary to travel toward any area of high hazard occupancy, in order to reach the nearest exit, unless the path of travel is effectively shielded from the high hazard location by suitable partitions or other physical barriers."



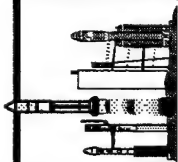
45th SPW Launch Site Fire Protection Requirements Analysis

29 CFR 1910, Occupational Safety & Health Standards (Continued) Subpart H - Hazardous Materials

● 1910.120 (q)(3) - Definitions

Emergency Response Corresponding To Emergencies

"A response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual-aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result in an uncontrolled release of a hazardous substance. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel are not considered to be emergency responses within the scope of this standard."



45th SPW Launch Site Fire Protection Requirements Analysis

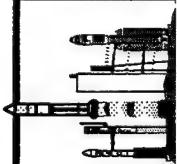
29 CFR 1910, Occupational Safety & Health Standards (Continued) Subpart H - Hazardous Materials

● 1910.120 (q) - Emergency Response To Hazardous Substance Releases

(1) Emergency Response Plan.

"An emergency response plan shall be developed and implemented to handle anticipated emergencies prior to the commencement of emergency response operations."

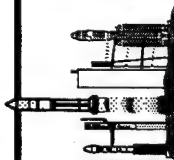
"Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph, if they provide an Emergency Action Plan, in accordance with Section 1910.38(a) of this part."



45th SPW Launch Site Fire Protection Requirements Analysis

29 CFR 1910, Occupational Safety & Health Standards (Continued) Standard 1910.1200 - Hazard Communication

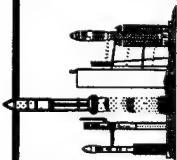
- **1910.1200 (a) Purpose.** "---communicating information concerning hazards and appropriate protective measures to employees, may include, for example, but is not limited to, provisions for: developing and maintaining a written hazard communication program for the workplace, including lists of hazardous chemicals present;preparation and distribution of material safety sheets to employees.....; and development and implementation of employee training programs regarding hazards of chemicals and protective measures."
- **1910.1200 (b)(2) Scope and Application.** "This section applies to any chemical which is known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency."



45th SPW Launch Site Fire Protection Requirements Analysis

29 CFR 1910, Occupational Safety & Health Standards (Continued) Standard 1910.1200 - Hazard Communication (Continued)

- 1910.1200 (b)(4)(iii) Scope and Application. "Employers shall ensure that employees are provided with information and training in accordance with paragraph (h) of this section....., to the extent necessary to protect them in the event of a spill or leak of a hazardous chemical from a sealed container."
- 1910.1200 (h)(3)(iii) Training. "Employee training shall include at least:
.....The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used."



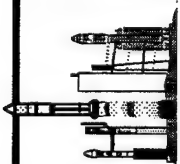
45th SPW Launch Site Fire Protection Requirements Analysis

29 CFR 1910, Occupational Safety & Health Standards (Continued) **Subpart H - Hazardous Materials**

- 1910.38 (a) (Subpart E) Employee Emergency Plans & Fire Prevention Plans
 - (1) Emergency Action Plan - Scope & Application. "The emergency action plan shall be in writing and shall cover those designated actions employers and employees must take to ensure employee safety from fire & other emergencies."
 - (3) Alarm System. "(i) The employer shall establish an employee alarm system which complies with Section 1910.165."
 - (5) Training. "Before implementing the emergency action plan, the employer shall designate & train a sufficient number of persons to assist in the safe and orderly emergency evacuation of employees."

SPC EMERGENCY ACTIONS PLAN RATIONALE

SPILL/RELEASE DESIGNATION	INCIDENTAL RELEASE 29 CFR 1900.1200 29 CFR 1900.120(q)(11)(ii)	EMERGENCY RESPONSE 29 CFR 1900.120 (q)
DEFINITION	<p>Small spill; can be cleaned up by workers at the spill site; releases do not present potential safety or health hazard from fire, explosion or chemical exposure.</p> <p>No environmental pollution results.</p>	<p>Release is beyond the SPC immediate response capability or pollutes the environment; potential for fire, explosion personnel injury or imminent danger from chemical exposure.</p> <p>911 response is by KSC HAZMAT Response Team augmented by SPC Contingency Crew personnel.</p>
WRITTEN PLANS	Hazard Communication Plan	Emergency Response Plan
ACTIVITIES	Containment, neutralization, decontamination & cleanup	Containment, neutralization, decontamination & cleanup
WHO CARRIES OUT ACTIVITIES	SPC workers at the spill site.	BOC HAZMAT Team. SPC Contingency Crew used for system safing, & HAZMAT containment & cleanup, as required.



45th SPW Launch Site Fire Protection Requirements Analysis

AFOSH Standard 127-56, Occupational Safety, 23 Nov 92
Fire Protection and Prevention

Responsibility For Portable Fire Extinguishers:

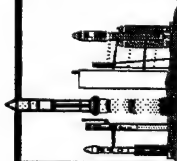
- Fire Chief - Determines need, type, size & location. Tests & maintains.
- Using Organization/Supervisor - Schedules/documents training. Funds purchase. Conducts monthly inspections.

Fire Detection & Suppression Systems:

- They provide fire safety for facilities, operations & personnel IAW AF guidance & NFPA codes.
- Where installed, supervisors/bldg managers shall train employees to operate installed systems & use the system for its intended purpose. The system will not be disabled without Fire Chief approval.

Life Safety

- Functional managers, supervisors and building managers are responsible for keeping facilities in a condition which provides a safe workplace according to NFPA 101 (Life Safety Code).



45th SPW Launch Site Fire Protection Requirements Analysis

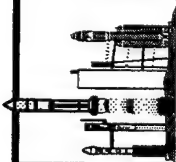
AFOSH Standard 127-43, Occupational Safety, 21 Sep 80
Flammable & Combustible Liquids

Fire Prevention:

- At least one 10-BC rated or greater fire extinguisher will be located outside and within 10-feet of the door opening into any room used for storage.

Spills:

- Plans will be made and means provided to promptly remove all spills.



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MIL-HDBK-1008B, 15 Jan 94

Fire Protection For Facilities Engineering, Design & Construction

Ordnance Facilities:

Facilities used for "handling, processing, servicing, and inspection of ammunition, explosives, propellants and oxidizers or related devices containing these materials....."

Fire Protection for Ordnance Facilities:

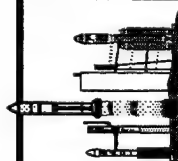
- High Speed (0.5 seconds or less) Automatic Sprinkler System
- Compliance w/DODI 6055.9, DOD Ammunition & Explosive Safety Standard

Flammable/Hazardous (Flam/Haz) Storage:

Facilities used for "storage of flammable & combustible liquids, as well as storage of materials which are classified as hazardous materials."

Fire Protection for Flam/Haz Storage Facilities:

- Detection & Automatic Sprinkler System per NFPA 30 (Water or Foam).
- Sprinkler system & 4-hr fire rated exterior walls for HAZMAT waste storage areas attached to another structure (2-hr, if stand-alone).



45th SPW Launch Site Fire Protection Requirements Analysis

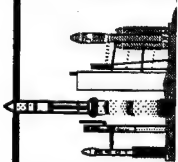
MIL-HDBK-1008B, 15 Jan 94 (Continued)
Fire Protection For Facilities Engineering, Design & Construction

Aircraft Hangars:

Requirements apply to "fuel cell maintenance facilities, corrosion control & protective coating and general purpose maintenance hangars."

Hangar Fire Protection:

- Wet-pipe, closed head AFFF-water sprinkler system in aircraft servicing area.
- Site specific combinations of manual, heat & optical detector activation.



45th SPW Launch Site Fire Protection Requirements Analysis

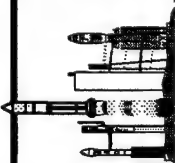
Engineering Technical Letter 93-5
Fire Protection Engineering Criteria, 22 Dec 93
- Electronic Equipment Installations

Mission Essential Electronic Equipment:

"Electronic equipment which has a direct impact on combat mission capability, including equipment integral to combat mission assets or used in direct control of these assets."

Fire Protection for Mission Essential Electronic Equipment:

- Automatic wet pipe sprinkler system (NFPA 13) for entire facility. Optional 4-hr fire wall separation & no sprinkler for electronic equipment space only.
- Electronic equipment & air handling power disconnect system (NFPA 70).
- Ultrasensitive smoke detectors in electronic equipment spaces (NFPA 72).
- Electronic equipment spaces separated by minimum 1-hr fire wall construction.
- Air handling system automatic smoke/fire dampers, if serves electronic equipment space & other areas (NFPA 90A).
- Separate smoke exhaust system w/standby power.
- Minimum combustible materials/plastics, etc.



45th SPW Launch Site Fire Protection Requirements Analysis

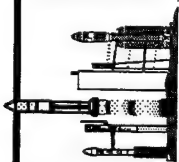
NFPA 101, Life Safety Code

Chapter 2, Fundamental Requirements

- Section 2-1 - "Every building or structure, new or old, designed for human occupancy shall be provided with means of egress and other safeguards sufficient to permit the prompt escape of occupants or shall furnish other means to provide a reasonable degree of safety for occupants."

Chapter 4, Hazard Of Contents

Section 4-2.1.2 - "Hazard of contents shall be determined by the authority having jurisdiction on the basis of the character of the contents and the processes or operations conducted in the building or structure."



45th SPW Launch Site Fire Protection Requirements Analysis

NFPA 101, Life Safety Code (Continued)

Chapter 6, Features of Fire Protection

- Section 6-4.1.1, Special Hazard Protection - Protection from any area having a degree of hazard greater than that normal to the general occupancy of the building or structure shall be provided as follows:
 - **Enclose the area with a 1-hr rated fire barrier**
 - **Protect the area with automatic extinguishing systems**
 - **Do both when the hazard is severe, or where otherwise specified**

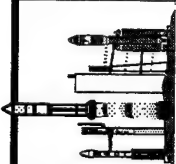
- Section 6-4.3, Flammable Liquids - Flammable liquids shall be protected IAW NFPA 30, Flammable & Combustible Liquids Code



45th SPW Launch Site Fire Protection Requirements Analysis

NFPA 30, Flammable & Combustible Liquids Code

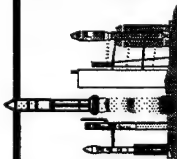
- Section 5-6.1.2 The wide range in size, design, and location of liquid processing facilities precludes the inclusion of detailed fire prevention and control systems and methods applicable to all such facilities. The authority having jurisdiction shall be consulted on specific cases, where applicable: otherwise, qualified engineering judgement shall be exercised per 5-6.1.3.



45th SPW Launch Site Fire Protection Requirements Analysis

NFPA 30, Flammable & Combustible Liquids Code (Continued)

- Section 5-6.1.3 The extent of fire prevention and control provided for the liquid processing facility shall be determined by an engineering evaluation of the operation, followed by the application of sound fire protection and processengineering principles. The evaluation shall include, but not be limited to:
 - **Analysis of fire and explosion hazards of the liquid operations.**
 - **Analysis of hazardous materials, hazardous chemicals, or hazardous reactions in the operations and the safeguards taken to control such materials, chemicals, or reactions.**
 - **Analysis of facility design requirements of the code.**
 - **Analysis of liquid handling, transfer & use requirements of the code.**
 - **Consideration of fire department or mutual aid response.**
- Section 5-6.7.3 Fixed Fire Control Equipment - Where the need is indicated by the hazards of liquid processing, storage or exposure as determined by 5-6.1.3, fixed protection may be required utilizing approved sprinkler systems.....fire resistive materials, or a combination of these.



45th SPW Launch Site Fire Protection Requirements Analysis

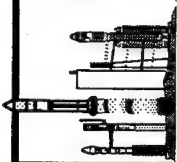
NFPA 101, Life Safety Code (Continued)
Chapter 28, Industrial Occupancies

- ***Section 28-1.4.1(c), High Hazard Industrial Occupancy***

"Includes buildings having high hazard materials, processes or contents."

- ***Section 28-3.2, Protection***

"Every high hazard industrial occupancy, operation, or process shall have automatic extinguishing systems or such other protection appropriate to the particular hazard, such as explosion venting or suppression, protecting any area subject to an explosion hazard for the purpose of minimizing danger to occupants in case of fire or other emergency before they have time to utilize exits to escape".



45th SPW Launch Site Fire Protection Requirements Analysis

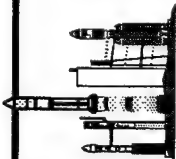
NFPA 101, Life Safety Code (Continued)
Chapter 28, Industrial Occupancies

- **Section 28-2.2.11, Slide Escapes**

"Approved slide escapes complying with 5-2.10 shall be permitted as components in 100 percent of the required means of egress for both new and existing high hazard industrial occupancies. Slide escapes shall be counted as means of egress only when regularly used in drills so that occupants are familiar with their use through practice." before they have time to utilize exits to escape".

- **Chapter 5, Means of Egress, Section 5-2.10.2.1, Slide Escape Capacity**

"Slide escapes, where permitted as a means of egress, shall be rated at a capacity of 60 persons."



45th SPW Launch Site Fire Protection Requirements Analysis

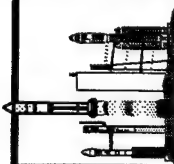
NFPA 101, Life Safety Code (Continued)

Chapter 5, Means Of Egress

- Section 5-1.3.5 Exit Access Corridors - "Corridors used as exit access and serving an area having an occupant loading of more than 30 shall be separated from other parts of the building by walls having a 1-hour fire resistance rating in accordance with 6-2.3."

"Exception #1: Existing buildings, provided the occupancy classification does not change."

- Section 5-2.2.6.3 Separation and Protection Of Outside Stairs - "Outside stairs shall be separated from the interior of the building by walls with the fire resistance rating required for enclosed stairs with fixed or self-closing opening protectives."
- Section 5-2.6.2 - Exit Passageways, Enclosure - "An exit passageway shall be separated from other parts of the building as specified in 5-1.3.1." (5-1.3.1 requires 2-hr fire walls where the exit connects 4 or more stories)

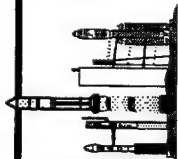


45th SPW Launch Site Fire Protection Requirements Analysis

Mandatory Life Safety Requirements (HQ AFSP/CE/SE Ltr, 12 May 94)

NFPA 101, Section 5-11, Special Provisions For Occupancies With High Hazard Contents

- 5-11.1: -----"exits of such types and numbers shall be provided and arranged to permit all occupants to escape from the building or structure or from the the hazardous area thereof to the outside or to a place of safety with a travel distance of not more than 75 ft, measured as specified in 5-6.2."
- 5-11.3: "At least two means of egress shall be provided from each building or hazardous area thereof."
- 5-11.4: "Means of egress shall be arranged so that there are no dead ends in corridors."



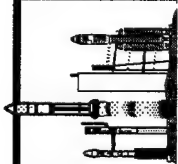
45th SPW Launch Site Fire Protection Requirements Analysis

NFPA 101, Life Safety Code (Continued)
Chapter 30, Special Structures & High Rise Buildings

- ***Section 30-3.2, Protection From Hazards***

" Any hazardous area, to the extent required by the applicable occupancy Chapter (Industrial) shall be protected IAW Section 6-4."

Exception #1: "Every special structure shall have automatic, manual or other protection, as might be appropriate to the particular hazard, that is designed to minimize danger to occupants in case of fire or other emergency before they have time to utilize the means of egress."

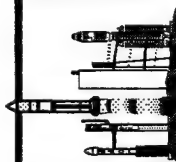


45th SPW Launch Site Fire Protection Requirements Analysis

NFPA 101, Life Safety Code (Continued) Chapter 30, Special Structures & High Rise Buildings

● Commentary on Section 30-3.2, Protection From Hazards

"The provisions of Section 30-3.2 require carefull analysis by Code users to ensure that fire protection required for life safety is provided. The key element of the requirement is that the fire protection be adequate to safeguard occupants during the time required to reach exits. Fire protection systems that may be needed for property protection or to control fire losses in a process or occupancy will, in many cases, be excessive for the life safety of the occupants, and are beyond the scope of this code."



45th SPW Launch Site Fire Protection Requirements Analysis

AFR 127-100, Explosives Safety Standards

- ***Para. 3-7a, Auxiliary Firefighting Equipment - Fire Extinguishers***

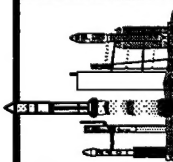
"A minimum of two fire extinguishers, suitable for the hazards involved, will be available for immediate use when explosives are being handled....."

- ***Para. 3-8, Storage of Water For Firefighting***

"Adequate water to fight fires must be available."

- ***Para. 3-9, Access To Fire Hose***

"A standard hose, as required, should be prepositioned and connected to fire hydrants where deemed necessary by the fire chief."



45th SPW Launch Site Fire Protection Requirements Analysis

AFR 127-100, Explosives Safety Standards (Continued)

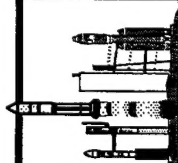
- **Para. 8-15a, Fire walls**

"As a minimum, 2-hour fire walls will be installed between explosives operating bays, cubicles, etc., and other areas not involved in munitions activities."

- **Para. 8-19, Building Exits**

"One properly located exit is suitable for small operating rooms or cubicles that have substantially constructed walls on three sides if personnel are limited to the minimum required to do the task."

Subpara b. "If more than eight persons are employed in the room, it should have additional exits on the basis of one exit for each additional group of five persons (or fraction thereof)."



45th SPW Launch Site Fire Protection Requirements Analysis

AFR 127-100, Explosives Safety Standards (Continued)

- **Para. 8-19, Safety Chutes**

"Safety chutes will be provided as exits from multistory hazardous locations where rapid egress is vital and cannot be otherwise obtained."

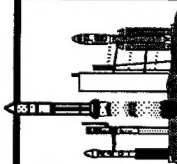
Subpara b. "These chutes must be provided for work levels above the ground floor. They should be placed on opposite sides of the operation (so that people will not be trapped by a fire between them and a single exit)."

- **Para. 8-41, Automatic Sprinkler Systems**

"The proper system should be determined by engineering studies of the hazards involved."

- **Para. 8-42, Deluge Systems**

"Machinery or operations in which there is a process fire hazard will have an auto deluge system. Quick acting sensors such as UV detectors will be used. In addition, hand-operated, quick acting deluge control equipment should be provided."



45th SPW Launch Site Fire Protection Requirements Analysis

AFR 127-100, Explosives Safety Standards (Continued)

- **Section C - Commander's Risk Assessment, Para 1.7, Risk Assessment**

"The Q-D criteria specified by this regulation are based on the best information currently available and are considered necessary to make an informed decision on the proper mix of combat readiness and safety....."

"Deviations to explosives safety standards must reflect the conscious managerial decision that operational necessity outweighs the additional risk that a particular course of action entails....."

"..... The key to using this model (Fig 1-1 for risk management) is accurate identification of the three risk factors, mishap severity, mishap probability, and mission exposure....."

".....the local commander is ultimately responsible for acceptance of the additional risk."

LIST OF REFERENCES

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2. Personal Communication, John Storm With John Dematteis, Jacobs Services Company, Vandenberg AFB, CA, January 17, 1995.
3. Product Literature, "The EVAC Rescue Chute", EVAC Systems, Inc., Prairie Village, KS, 1995.
4. Product Literature, "Baker Life Chute", Baker Safety Equipment Inc., New Castle, DE, 1995.
5. Thompson, T.S., "Mission Needs And Operational Requirements Guidance And Procedures", Air Force Instruction 10-601, Headquarters, United States Air Force, Washington, D.C., May 31, 1994.
6. Hawn, S., "Draft ORD For Combined Fire Fighting/HAZMAT Ensemble With Body Cooling", Memo to ASC/YOCC & WL/FIVCF, BDM Management Systems Company, Tyndall AFB, FL, May 11, 1994.
7. McPeak, M., General, "Fire Fighting Ensemble - INFORMATION MEMORANDUM", CAF Operational Requirements Document CAF 004-85-I-Q, Memorandum For SAF/AQ, Headquarters, United States Air Force, Washington, D.C., May 8, 1994.
8. McPeak, M., General, "CAF New Generation of Firefighting and Crash Rescue Systems - INFORMATION MEMORANDUM", Air Combat Command Mission Need Statement CAF 311-90, Memorandum For SAF/AQ, Headquarters, United States Air Force, Washington, D.C., May 8, 1994.
9. "Occupational Safety And Health Standards", Part 1910, Title 29, Code of Federal Regulations, Chapter XVII, "Occupational Safety and Health Administration, Department of Labor", July 1, 1992.